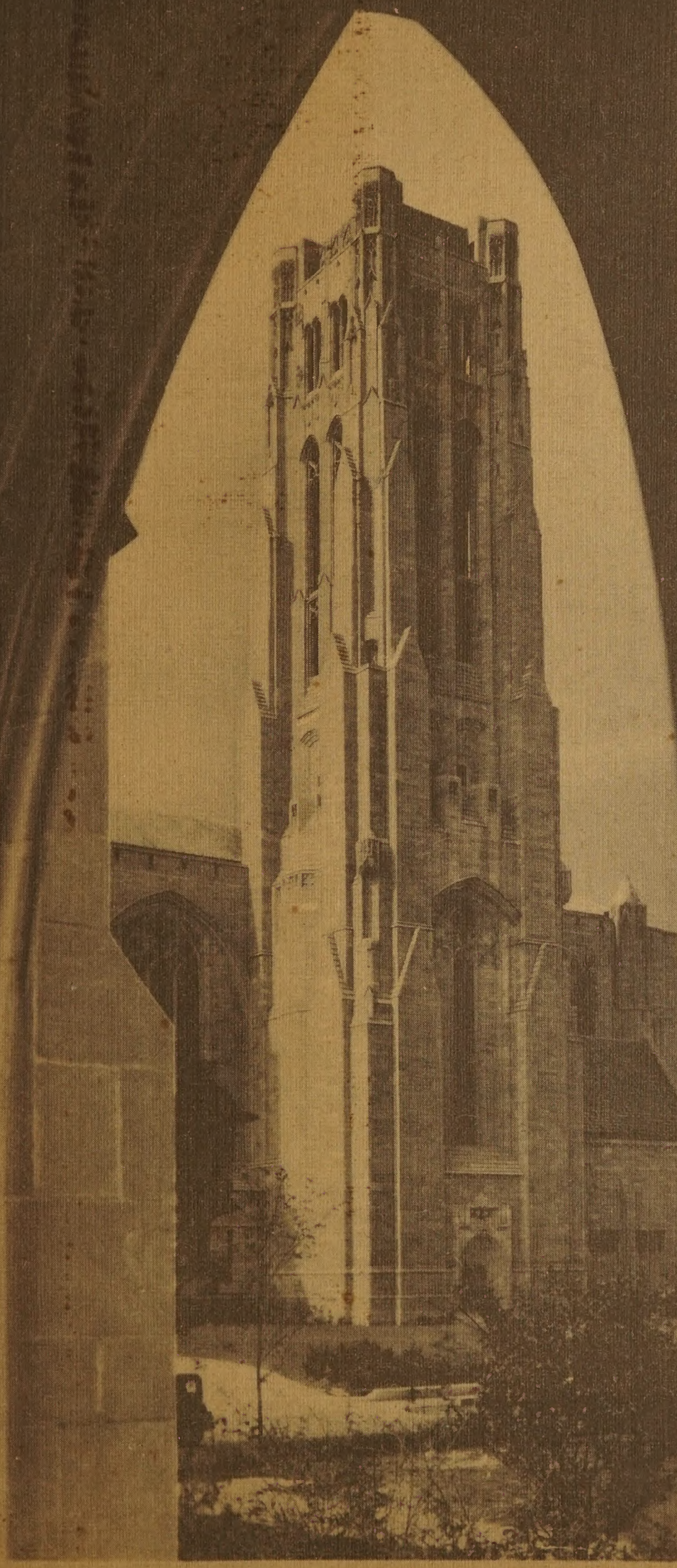
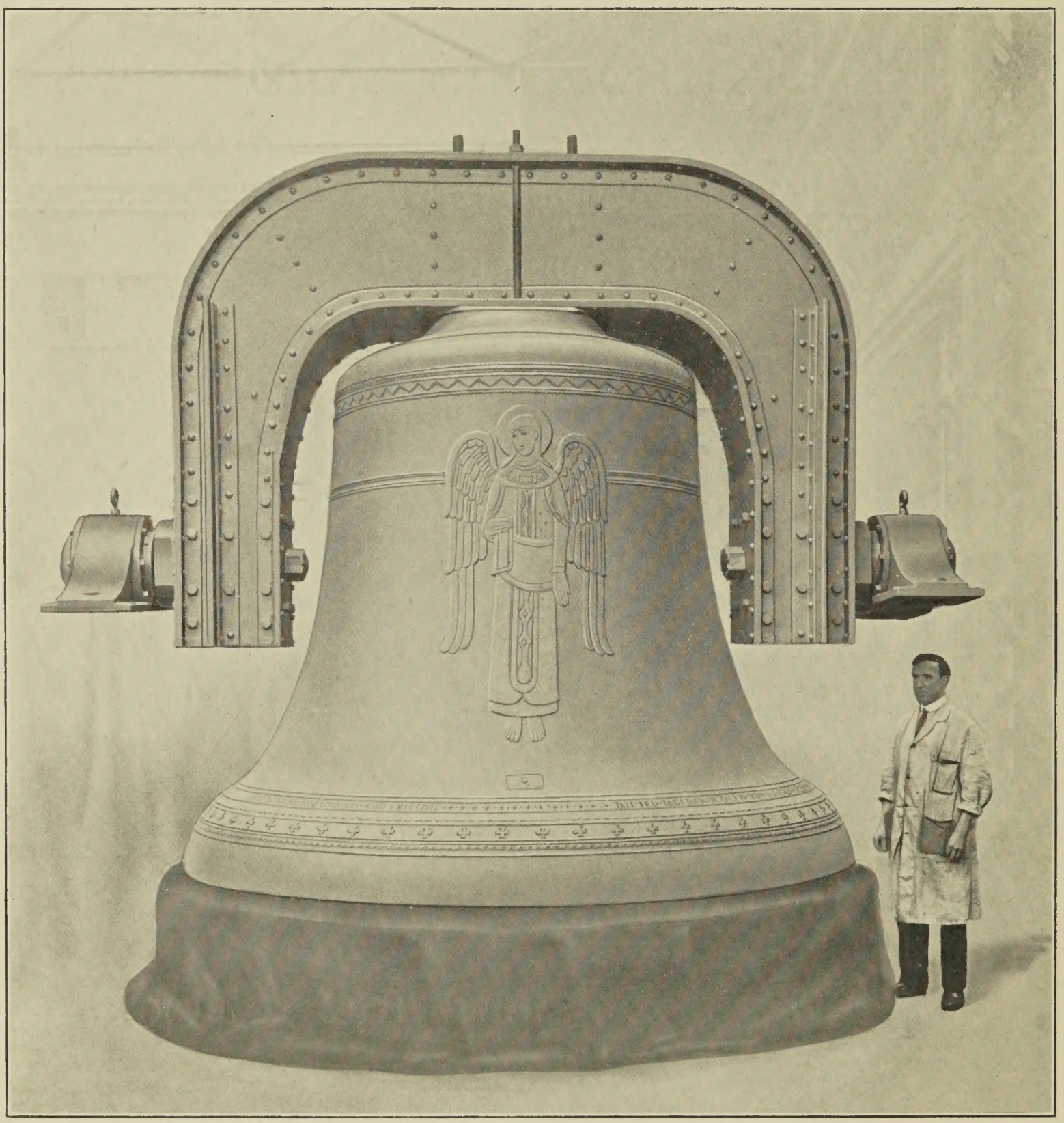
CARILLONS, CHIMES, TOWER CLOCKS



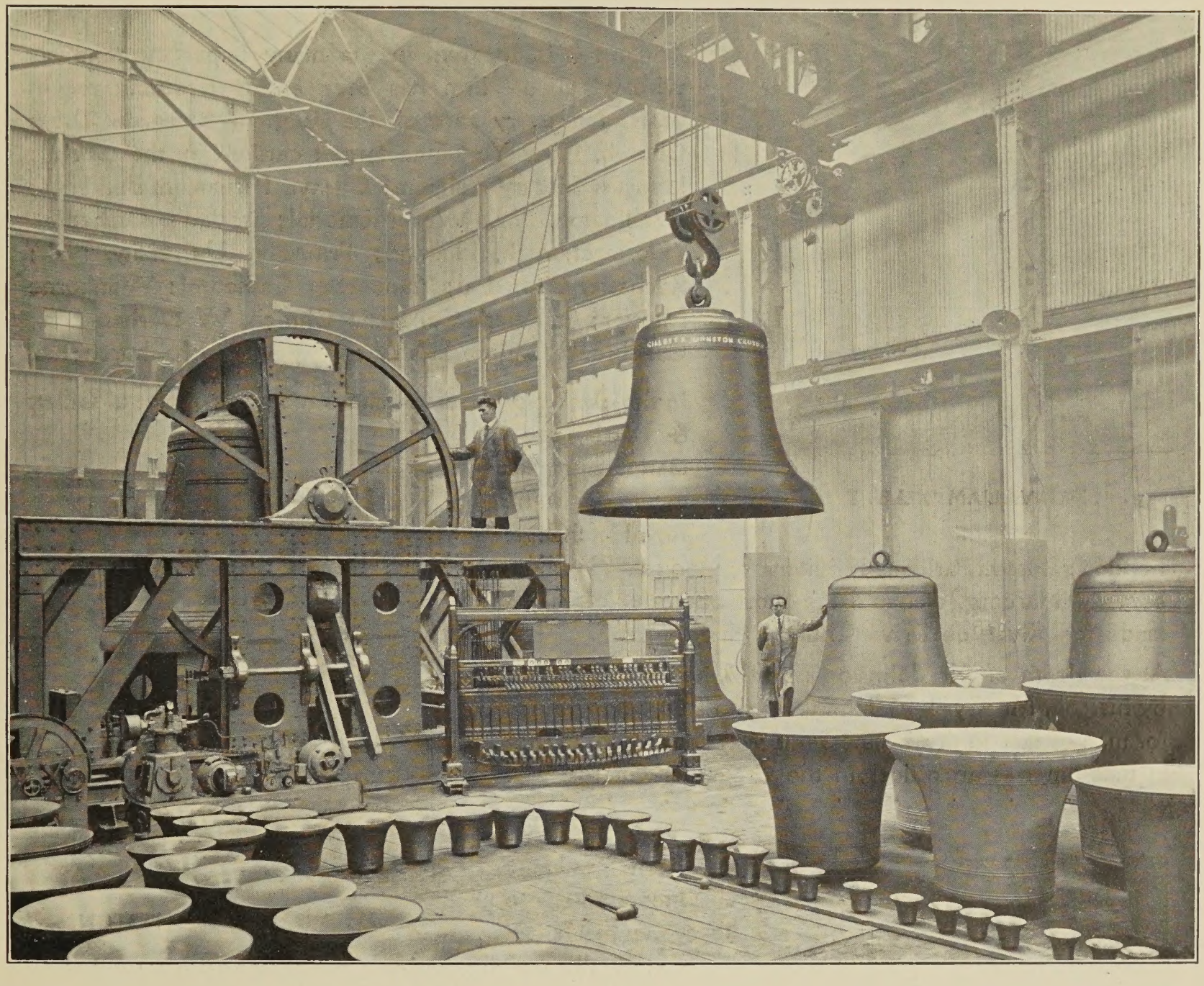
Riverside Drive Church, New York City, N.Y.



The Bourdon Bell

Note	C
Weight	18¼ tons (40,880 lbs.)
Diameter	10′-2″ (122 inches.)

HEAVY ERECTING SHOP.



History of the Firm

MR. WILLIAM GILLETT originally began work as a small clockmaker in the village of Hadlow, in Kent, where he received the patronage of the then Lord Sackville of Knowle.

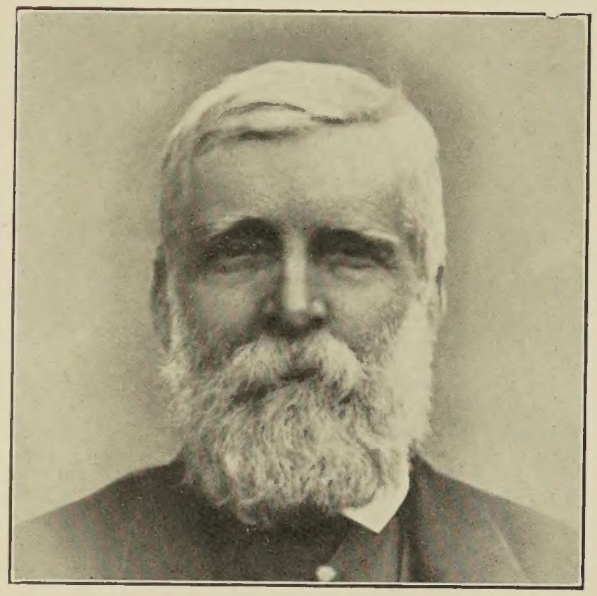
From there he migrated to Clerkenwell and he finally established the present business on its existing site at Croydon in 1844.

Subsequently he was joined by Mr. Charles Bland, and the firm became known as "Gillett & Bland."

In 1877, when Mr. Arthur A. Johnston became a partner, the name of the firm was changed to "Gillett & Johnston," as at present, and the business—which had hitherto been confined to the manufacture of clocks—was further extended by the development of the Bell Foundry.

This branch of the business has made rapid strides since improved methods of manufacture were introduced in the casting, tuning and hanging of bells.

History of the Firm—*continued.*



Mr. WILLIAM GILLETT

The result is apparent in the many important contracts with which the firm has been entrusted during recent years, for every part of the world — Riverside Drive Church, New York (the largest carillon in the world); Louvain Library, Belgium; Ottawa Parliament Buildings; Wellington, N.Z. War Memorial; St. Jan's. Cathedral, s'Hertogenbosch, Holland; Princeton University, N.J.; Rochester Cathedral; Manchester Cathedral; Wimborne Minster; St. Peter's Collegiate Church, Wolverhampton; Carisbrooke Church, I.O.W.; Watford Parish Church; etc.

In the clock world, some famous recent examples of Gillett & Johnston manufacture are to be seen at the Royal Exchange, London; Ottawa Parliament Buildings; Montreal Harbour; Bombay Harbour, etc., and the most powerful clock yet made for Riverside Drive Church, New York.

Mr. ARTHUR A. JOHNSTON

At the death of Mr. Johnston in 1916, he was succeeded by his son, Mr. Cyril F. Johnston, who had been trained for many years in the business but was serving in France at that time, as an officer in the Grenadier Guards.

Mr. CYRIL F. JOHNSTON

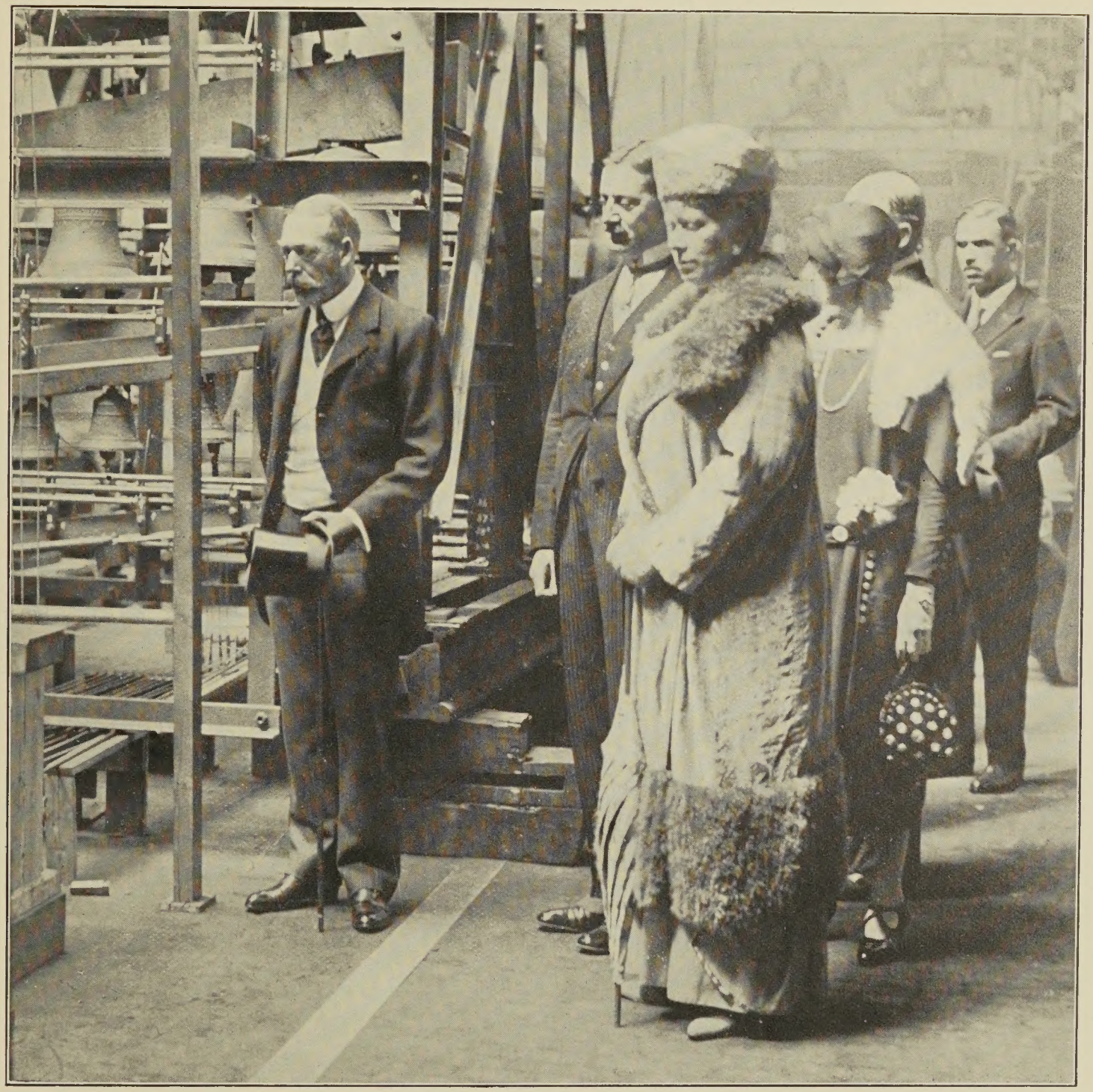
The Staff has been gradually increased to cope with the continually growing business, the personnel now including highly technical experts in the different branches of manufacture.

Of the employees, a considerable proportion have served for over 20 years, two of the men having worked 50 years with the firm.

The Inspectors of Belfries are expert change-ringers, as also are the bell-hangers entrusted with the installation of ringing peals.

The present output of the factory in one month, equals that of a year's working seven years ago.

A Royal Visit



Their Majesties, the King and Queen, inspecting, at the Foundry, the Carillon of 53 bells for Park Avenue Baptist Church, New York; Tuesday, May 12th, 1925

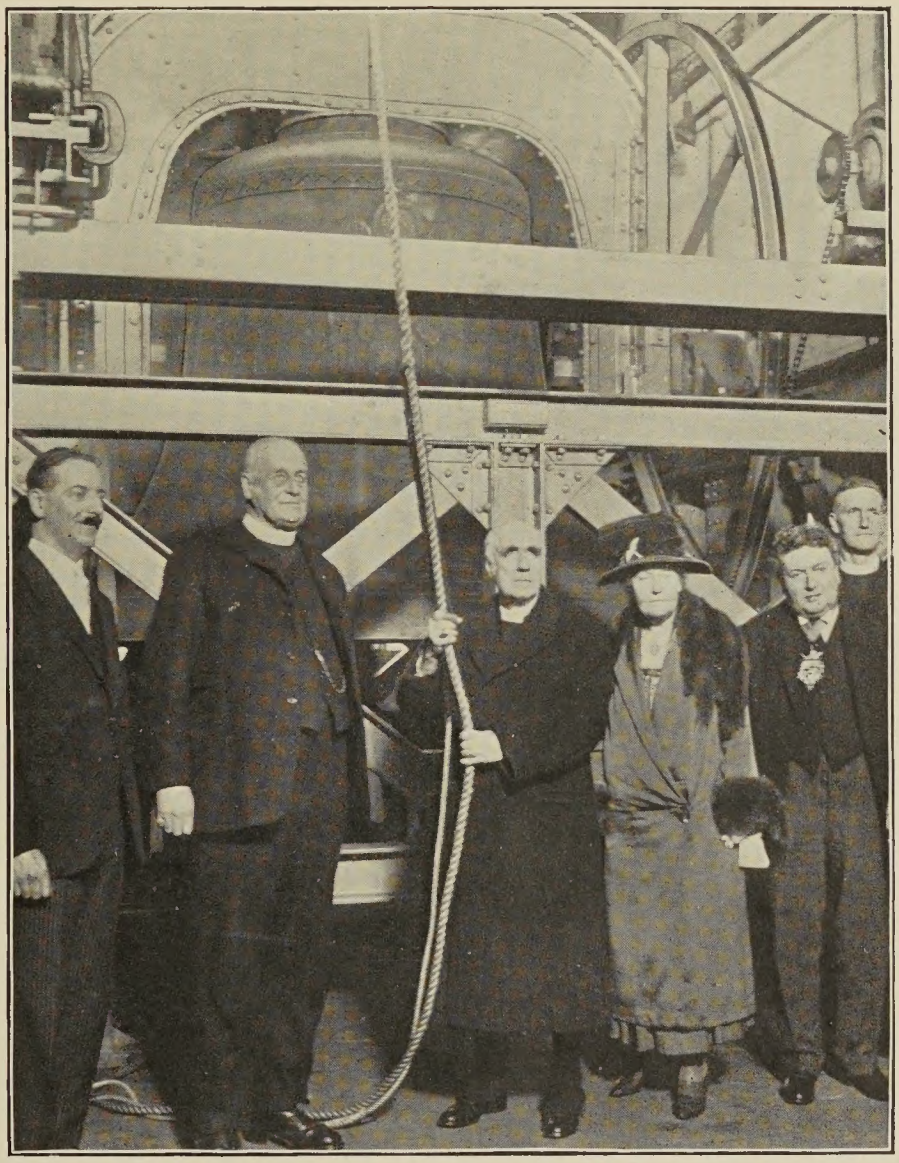
Distinguished Visitors

The firm has been honoured from time to time by visits from many distinguished visitors, including:

	DATE
T.R.H. the Duke of Connaught and Princess Patricia (now Lady Patricia Ramsay)	1918
H.R.H. the Princess Beatrice	1922 & 1925
H R.H. the late Duchess of Albany	1922
His Grace the Archbishop of Canterbury and Mrs. Randall Davidson	1927
The Hon. W. Mackenzie King, Prime Minister of Canada	1926
T.E. The American Ambassador and Mrs. Alanson Houghton	1925 & 1927
T.E. The Belgian Ambassador and Baroness Moncheur ...	1926
T.E. The Belgian Ambassador and Baroness de Cartier de Marchienne	1927

H.R.H. Princess Beatrice, H.R.H. the late Duchess of Albany, Lady May Cambridge and the late Lord Frematon, on the occasion of the recasting of the Ring of eight bells for Carisbrooke Church, I.O.W.

"All England" Ringers' Meeting at Croydon, 1928



The Archbishop of Canterbury Ringing the Great Bell

ON Saturday, March 3rd, 1928, 2,400 Ringers from all parts of England gathered at Croydon to view the largest bell ever cast in England (18¼ tons), for Riverside Drive Church, New York.

The Archbishop of Canterbury and Mrs. Randall-Davidson, the Bishop of Guildford, Canon G. F. Coleridge (President of the Central Council of Bell-Ringers), the Duke of Argyll, the Mayor and Mayoress of Croydon, and Canon E. S. Woods, Vicar of Croydon, were present.

Amongst the visitors were 41 ringing clergymen and 71 lady ringers.

After the visit to the Works, ringing on peals in the Croydon Churches, and tea, the whole assembly—representing 41 Diocesan Guilds and County Associations of Ringers—was addressed by His Grace the Archbishop of Canterbury.

Subsequently a concert, which included hand-bell ringing items by famous ringers, concluded the greatest Ringers' Meeting ever celebrated.

"All England" Ringers' Meeting at Croydon—*(continued)*

Arriving at the Foundry

"Tea Time"

Bells

First English Bells

BELLS were introduced into England by Bishop Paulinus of Nola in Campana about 400 A.D. Hence the word "campanology," meaning the study or use of bells. The first set of bells having consecutive notes was that installed in Crowland Abbey about 900 A.D. They were seven in number. The oldest dated bell in England—1296— is at Claughton, Lancs.

Moulding in the Foundry.

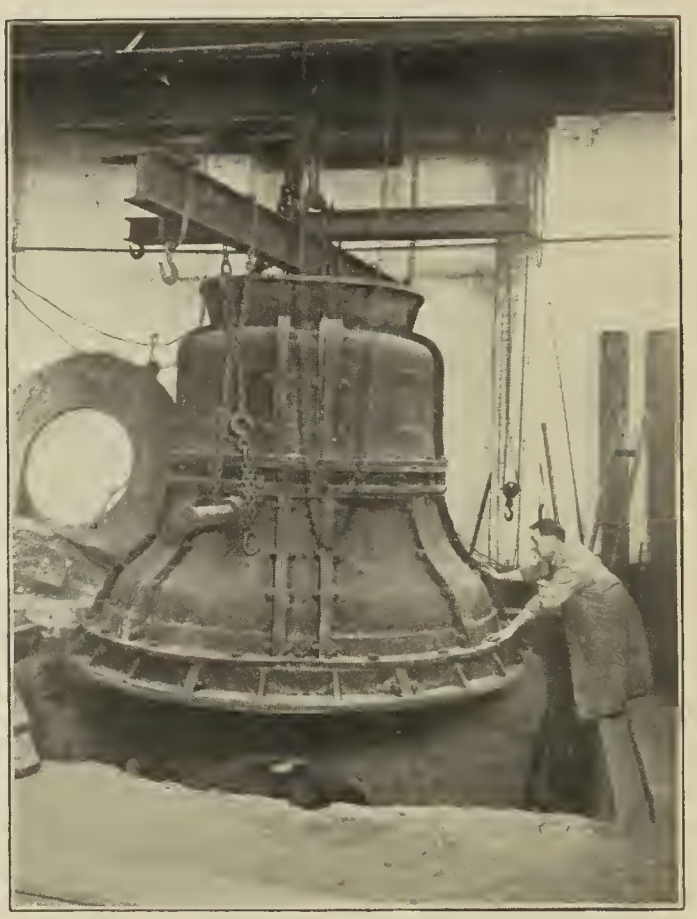
MOULDING.

In order to cast a bell two moulds are required. The outer mould is formed in an iron case, lined with loam; a strickle board ("sweep") is fixed to an arm which is supported by a central bar, and the "sweep" is rotated until it has shaped

Bells *(continued)*

the loam lining of the case into the form required for the exterior of the bell. The inner mould, called the core, consists of a structure built up of bricks, tier upon tier, coated with the same loam as that used in the case. This mould is formed by the other strickle board in a similar manner. These are called the first, or rough, coats, and the moulds are then placed in large ovens to be thoroughly dried. This process may take two or three days in the case of a medium-sized bell, and two or three weeks in the case of larger bells. The moulds are then brought out and coated a second time with a finer mixture of loam, and then returned

The "Core"



The "Case"

once more to the ovens to be dried. The next process is blacking the moulds and sleeking the surfaces so that the castings may come out clean and smooth. It is at this stage that inscriptions are stamped on the outer mould. The moulds are now ready to be put together, that is, the case to be fitted exactly over the core. This final operation is performed on the casting day, when the metal is tapped from the furnace, and poured from a large cauldron into the respective moulds of each bell. The casting of a ten ton bell can be accomplished in about 10 minutes.

Bells *(continued)*

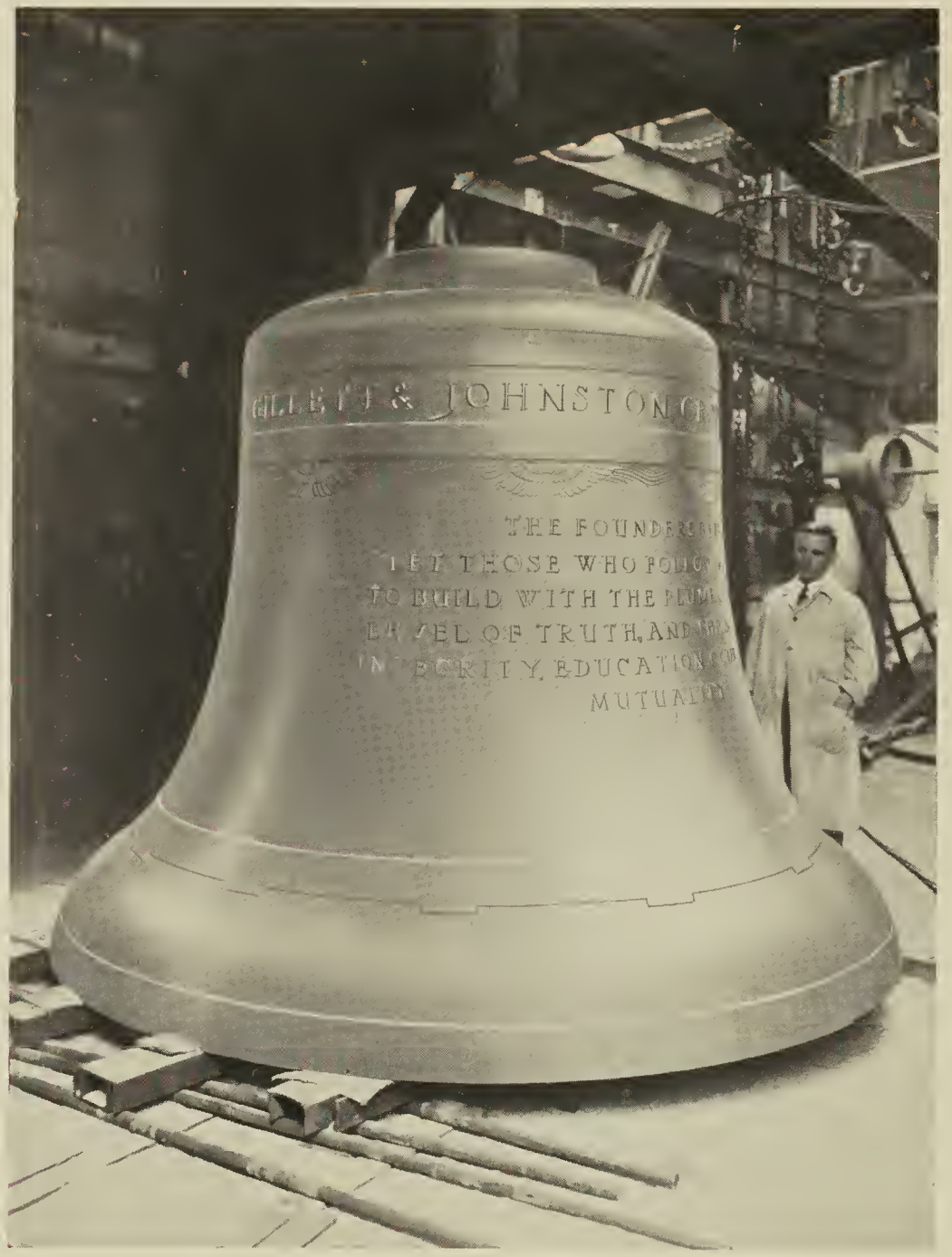
After the requisite time for cooling has elapsed, the moulds are parted, the core removed from the bell, which is then trimmed, sand-blasted and drilled—ready for tuning.

Casting

Drilling

METAL

Bell metal is composed of an amalgam of pure copper and tin in the right proportions. Great care is taken nowadays to ensure that only the purest metal is used, and that it is treated scientifically in the processes of preparation and melting.



The Wanamaker Bell

(Erected on Messrs. John Wanamaker's Store in Philadelphia)

Weight	15 tons 11 cwts. (34,832 lbs.)
Diameter	114"
Note	D

The bell is fixed on the roof of the Store, at a height of 300 feet. A gigantic electrically operated clock strikes the hours, and accurate time is broadcast daily.

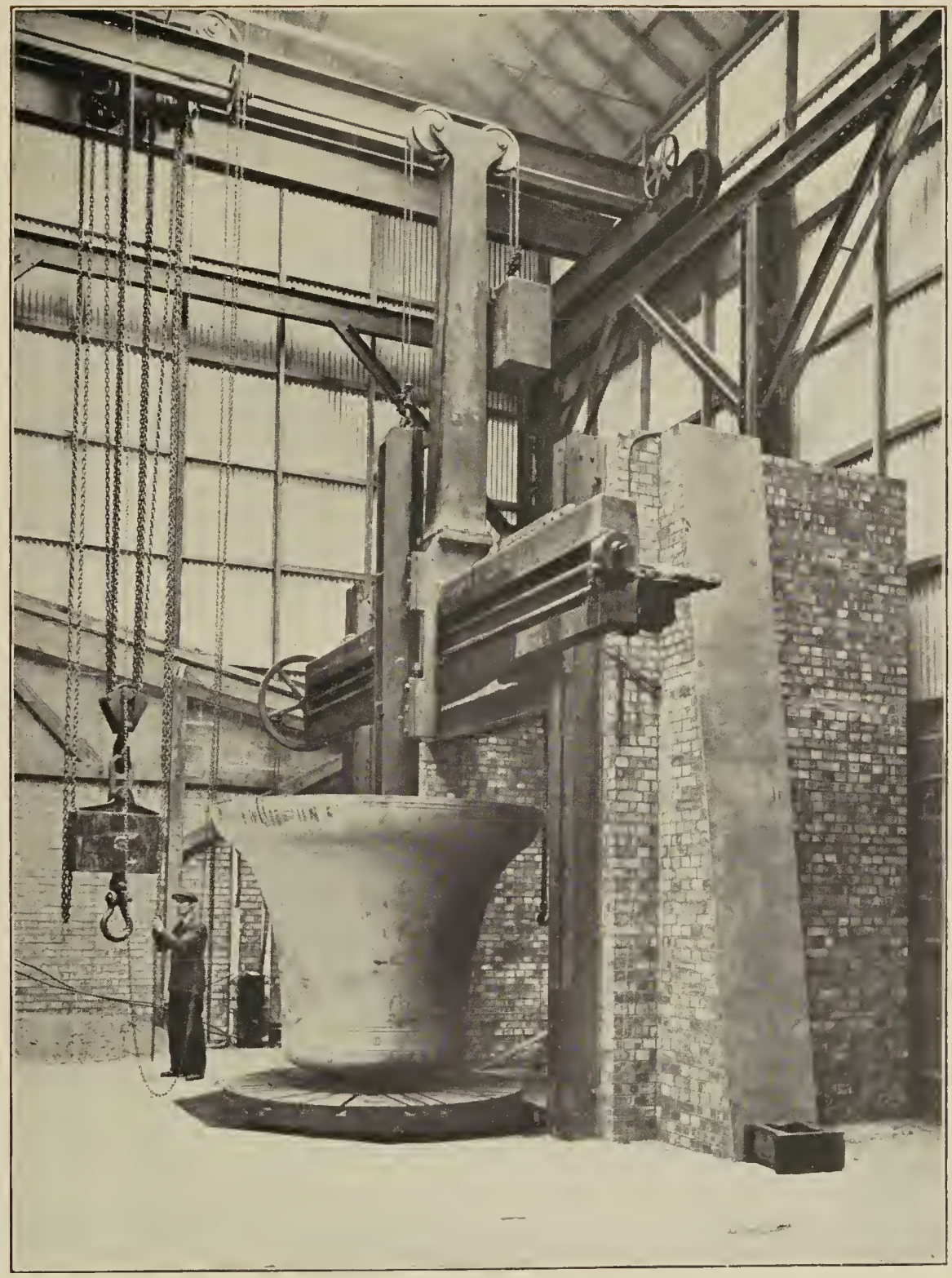
Inscription :

THE FOUNDER'S BELL.

"Let those who follow me continue
To build with the plumb of Honor, the
Level of Truth and the Square of
Integrity, Education, Courtesy and Mutuality."

¶ *The entire installation, including the bells, framework and clock mechanism, was manufactured at Croydon by Gillett & Johnston.*

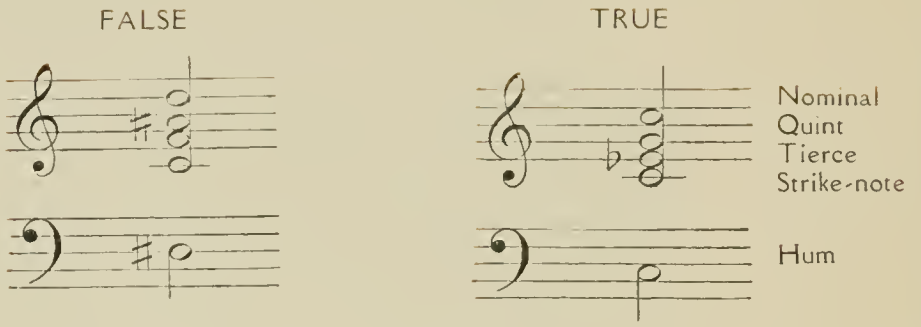
Tuning



The Largest Tuning Machine in the World.
The Bell revolves and the metal is pared away from the inside.

FOR two centuries the tuning of the harmonics in a bell was a lost art—the ordinary method being to treat the bell as a single note whereas it has *at least five notes that should be in tune with one another*—the strike-note, the nominal (octave above the strike-note), the hum (octave below), the tierce (third) and quint (fifth).

A Hemony Bell
Dated 1664



The two chords shown here give, in the one case, the tones of the average bell, which is false, and in the other those of a bell *in tune with itself.*

The Hemonys of Amsterdam, 1644-1684, were the most successful exponents of harmonical tuning before the present day, and they were followed by two Belgian firms, Dumery and the Van den Gheyns. Apart from these Dutch and Belgian masters, this higher method of tuning was not practised in any country and their knowledge was apparently lost with them — to be revived and improved upon in England during the last 25 years.

The incomparable improvement in tone that this brought about is due in great measure to the efforts of the late Canon Simpson, of Fittleworth, in Sussex. The Canon devoted the best part of his life to the study of bell tones and was insistent in his denunciation of existing methods and in a demand for better and more musical bells.

After a quarter of a century's continual practice in the dissection of bell tones and the application of improved methods and machinery, it is now possible to tune an extensive range of bells, exceeding five chromatic octaves, from 20-ton Bourdons up to little trebles weighing a few pounds, more accurately than the famous Hemonys did three hundred years ago.

That every bell should be accurately in tune with itself as well as with the other bells as a whole is an absolute necessity for Carillon work, but the benefit is almost as apparent in Ringing Peals and Single Bells, and the purity of tone resulting from three tones in octave with a true third and fifth has caused many an unmusical peal to be sent to the Foundry for re-casting and tuning on better lines.

Bell after Tuning

Re-casting.

WHEN it is possible to correct to a reasonable extent the harmonics of each bell in an old peal, whilst putting the peal into tune as a whole, this is done with the utmost care.

In each case, where it is found that the harmonics of an individual bell are too false for appreciable correction, or that it would be unwise to interfere with it unduly, it is the Firm's practice to point this out to the authorities.

If there are no historical or sentimental reasons against re-casting, this is then the only remedy, if funds permit.

On the other hand a bell that is really bad, but worthy of retention in its present form owing to antiquity, can be preserved in the Church, whilst a new one takes its place in the peal.

The Recast Ring of Ten for Rochester Cathedral.

St. Mary's Cathedral, Halifax N.S.

The eleven Bells in this tower were acknowledged to be discordant and also badly out of tune.

They were sent to the Croydon Foundry, where they were recast and returned to Halifax—a correctly tuned and musical chime.

The Recast Ring of Eight for Banstead Church, Surrey.

A General Description of the Carillon

THE word "Carillon" is derived from the Latin "quadrilionem," which was applied to sets of four bells that were erected in the towers of Northern France and the Low Countries centuries ago.

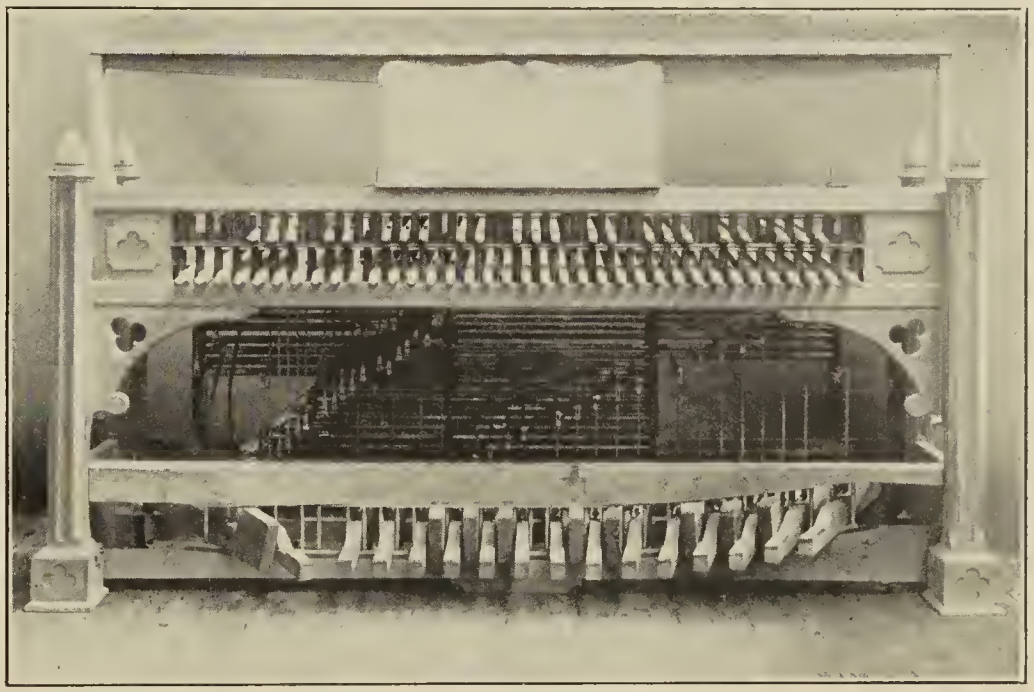
The number of bells in a tower was increased from time to time and the word "Carillon" remained until it came to mean a set of bells of the finest musical quality and tuning, advancing by semi-tones in the chromatic scale: it contains at least two octaves of bells, that is a minimum of twenty-three when the first two semi-tones are omitted; its average range is three octaves, or about thirty-five bells, and it attains a maximum compass of over five and a half octaves, or seventy-two bells.

It is usually operated by a Clavier, the arrangement of which is identical with the console of an organ, except that light wooden levers take the place of the ivory keys. These levers are attached by means of wires and cranks to the clappers, which strike the bell on the inside surface at a point near its largest diameter: the travel of the clapper is about one inch, which is sufficient to bring out the full volume of sound required for Carillon playing, while still allowing the delicate touch necessary to enable a single operator to manipulate so many bells.

Pedals are attached to the levers connected with the heavier bells, so that these can be played by foot or by hand; this enables the player to strike them more forcibly than would be possible with the hand levers, and it also allows him to execute the more intricate passages of music by leaving his hands free for the rapid manipulation of the levers connected to the smaller bells, playing the bass accompaniment with his feet.

This instrument, in the case of the smaller or two-octave Carillons, can be operated by anyone having an ear for music, and able to play on the piano. Beginning with simple airs and tunes, proficiency is rapidly attained and, with practice, more elaborate pieces with variations can be rendered effectively, the scope being only limited by the number of bells. Such a Carillon is admirably suited to the requirements of a church of average size, as the two octave range, practically that of the human voice, ensures that any hymn tune, song or well known air, can be played.

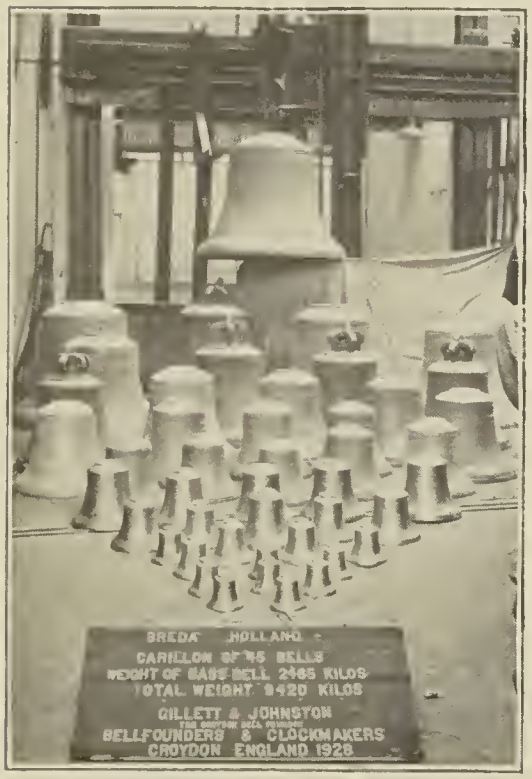
For a larger Church or for the tower of a Cathedral, University, City Hall or Government Building, it is usual to have a carillon of greater range and heavier calibre, and for this it is desirable that a Carillonneur, or Bell Organist, be appointed; that is a man with musical ability and training who would be able to devote a definite amount of time to mastering the key-board and studying the capabilities of the instrument.



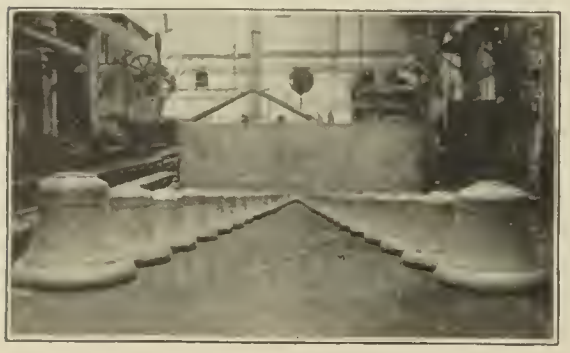
Clavier for Louvain Library Carillon

Carillons in hand and recently completed

St. Jans Cathedral, s'Hertogenbosch, Holland



Breda, Holland



St. Joseph's Church, Tilburg, Holland

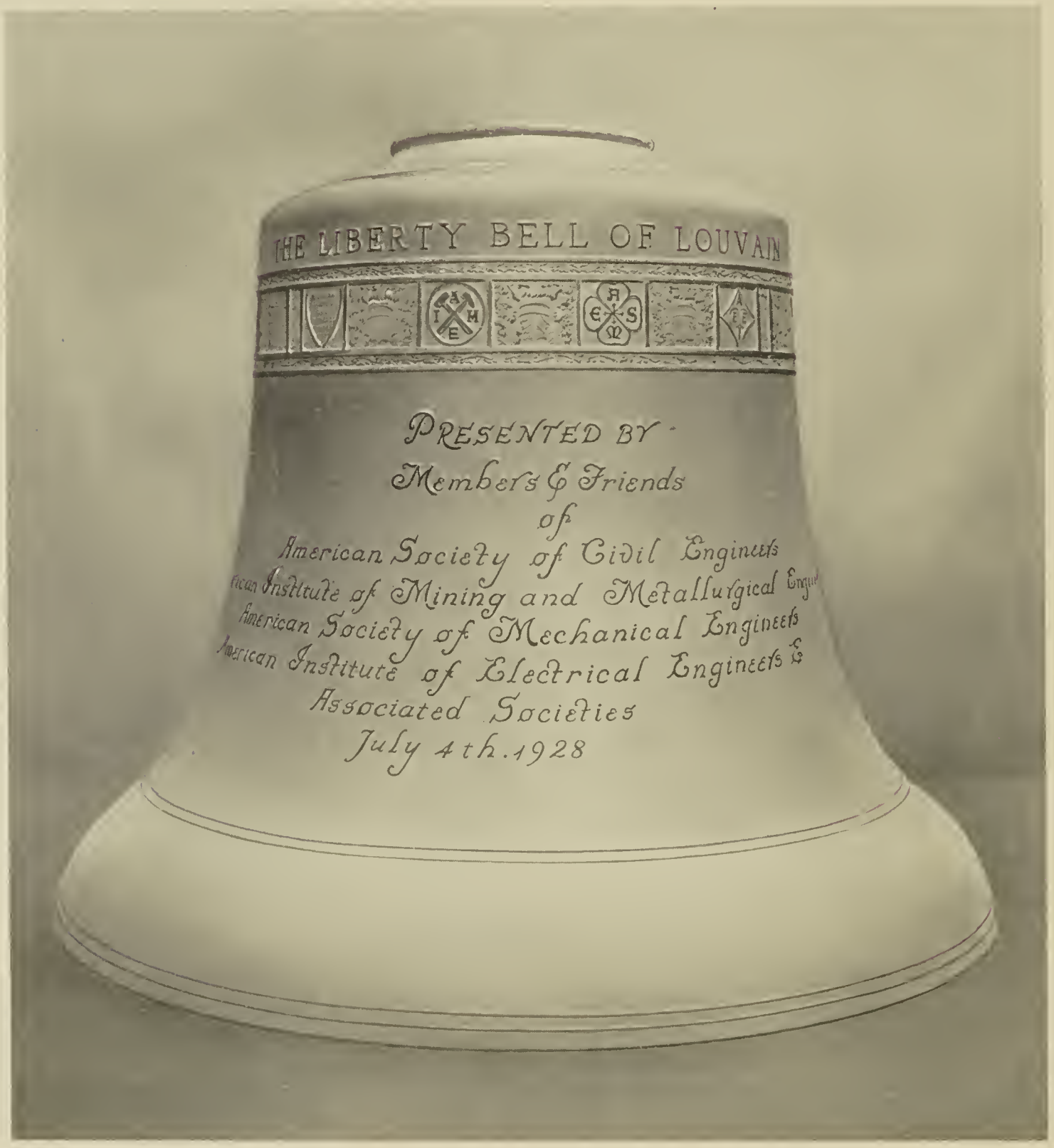
	Number of Bells	Weight of Heaviest Bell in Carillon				
		Tons	Cwts.	Qrs.	Lbs.	Lbs.
U.S.A.						
New York, Riverside Church	72	18	5	0	0	40,880
Chicago University	64	17	0	0	0	38,080
Philadelphia, Messrs. John Wanamaker ...	—	15	0	0	0	35,600
Princeton University, N.J.	35	5	15	0	0	12,880
Cohasset, Mass., St. Stephen's Church ...	51	5	0	0	0	11,200
Norwood, Mass.	50	3	10	0	0	7,840
Rochester, Mayo Clinic	23	3	8	0	0	7,616
Mercersburg Academy, Penn.	43	3	4	0	0	7,168
Chicago, St. Chrysostom's Church ...	43	2	8	0	0	5,376
Cincinnati Ohio	23	2	0	0	0	4,480
Plainfield, N.J., Grace Church	23	1	0	2	0	2,296
Detroit, Jefferson Avenue Presbyterian Church	23	1	0	2	0	2 296
Nashville, Tennessee, Ward Belmont College	23	—	13	0	0	1,456
CANADA						
Ottawa Parliament Buildings, Victory Tower	53	10	0	0	0	22,400
Toronto, Metropolitan Methodist Church ...	23	3	15	0	0	8,400
Toronto University	23	3	10	0	0	7,840
Guelph, Ont., St. George's Church ...	23	—	14	3	0	1,652
Simcoe, Ont., Norfolk Soldiers' Memorial ...	23	—	14	3	0	1,652
BELGIUM						
Louvain Library	48	7	0	0	0	15,680
HOLLAND						
Enschede	42	2	8	2	0	5,432
s'Hertogenbosch, St. Jans Cathedral ...	43	1	13	0	0	3,696
Tilburg, St. Joseph's Church	35	1	2	0	0	2,464
Almelo, R C. Church	36	—	18	0	0	2,016
Sneek	25	—	5	2	0	616
Barneveld	24	—	5	0	0	560
Hilvarenbeek	19	—	3	2	0	392
Breda	45	2	10	0	0	5,600
Oldenzaal	42	1	8	3	0	3,220
PALESTINE						
Jerusalem	35	1	8	0	0	3,136
NEW ZEALAND						
Wellington War Memorial	49	5	10	0	0	12,320
SCOTLAND						
Dumbarton, St. Patrick's Church	23	—	17	0	0	1,904
ENGLAND						
London, Bond Street (Messrs. Atkinsons) ...	23	—	13	0	0	1,456
London, Oxford Street	32	—	6	3	0	756

Weights & Notes of Bells for Carillons & Chimes

No.	Note.	Weight Cwts.	qrs.	lbs.	lbs.
1	E	0	0	11	11
2	D♯	0	0	11	11
3	D	0	0	11	11
4	C♯	0	0	11½	11½
5	C	0	0	11½	11½
6	B	0	0	11½	11½
7	A♯	0	0	11½	11½
8	A	0	0	12	12
9	G♯	0	0	12	12
10	G	0	0	12	12
11	F♯	0	0	12½	12½
12	F	0	0	12½	12½
13	E	0	0	13	13
14	D♯	0	0	14	14
15	D	0	0	15	15
16	C♯	0	0	17	17
17	C	0	0	20	20
18	B	0	0	24	24
19	A♯	0	1	0	28
20	A	0	1	4	32
21	G♯	0	1	10	38
22	G	0	1	21	49
23	F♯	0	2	7	63
24	F	0	2	14	70
25	E	0	3	0	84
26	D♯	0	3	14	98
27	D	0	3	21	105
28	C♯	1	0	7	119
29	C	1	0	14	126
30	B	1	1	7	147
31	A♯	1	2	0	168

No.	Note.	Weight Tons	cwts.	qrs.	lbs.	lbs.
32	A		1	3	0	196
33	G♯		2	0	0	224
34	G		2	1	7	259
35	F♯		3	0	7	343
36	F		3	2	14	406
37	E		4	1	7	483
38	D♯		4	2	14	518
39	D		5	0	0	560
40	C♯		5	1	0	588
41	C		6	0	0	672
42	B		7	1	0	812
43	A♯		8	0	0	896
44	A		10	0	0	1120
45	G♯		12	1	0	1372
46	G		14	2	0	1624
47	F♯		17	0	0	1904
48	F	1	0	0	0	2240
49	E	1	5	0	0	2800
50	D♯	1	8	2	0	3192
51	D	1	14	0	0	3808
52	C♯	2	2	2	0	4760
53	C	2	8	2	0	5432
54	B	2	19	0	0	6608
55	A♯	3	10	0	0	7840
56	A	4	3	0	0	9296
57	G♯	5	0	0	0	11200
58	G	5	15	0	0	12880
59	F♯	7	0	0	0	15680
60	F	8	5	0	0	18480
61	E	10	0	0	0	22400

The University Library of Louvain



THE BOURDON BELL

WEIGHT 7 TONS (15,680 Lbs.)

Weights of Carillons

23 Bells (Two Chromatic Octaves—omitting the two lowest Semitones).

BOURDON				Total Weight of Bells		* Total Weight of Bells, Frame and Fittings		Minimum Span of Belfry	Minimum Height of Belfry
Note	Dia.	Weight							
		Cwts.	Lbs.	Cwts.	Lbs.	Cwts.	Lbs.	Feet	Feet
A	37½″	10	1120	59	6608	122	13664	10	14
G	42″	14½	1624	79	8848	174	19488	11	14
F	47″	20	2240	116	12992	218	24416	12	14
E	50″	25	2800	125	14000	241	26992	13	15
D	56″	34	3808	172	19264	304	34048	14	16
C♯	60″	42½	4760	203	22736	345	38640	15	17
C	63″	48½	5432	239	26768	406	45472	16	18
B	67″	59	6608	284½	31864	489	54768	17	19
A♯	71″	70	7840	335	37520	573	64176	18	20

35 Bells (Three Chromatic Octaves—omitting the two lowest Semitones).

BOURDON				Total Weight of Bells		Total Weight of Bells, Frame and Fittings		Minimum Span of Belfry	Minimum Height of Belfry
Note	Dia	Weight							
		Cwts.	Lbs.	Cwts.	Lbs.	Cwts.	Lbs.	Feet	Feet
C♯	60″	42½	4760	209	23408	361	40432	15	20
C	63″	48½	5432	245	27440	423	47376	16	21
B	67″	59	6608	292	32704	504	56448	17	22
A♯	71″	70	7840	343	38416	591	66192	18	24
A	75″	83	9296	409	45808	681	76272	19	26
G♯	80″	100	11200	485	54320	808	90496	20	28
G	84″	115	12880	572	64064				

47 Bells (Four Chromatic Octaves— omitting the two lowest Semitones).

BOURDON				Total Weight of Bells		Total Weight of Bells, Frame and Fittings		Minimum Span of Belfry	Minimum Height of Belfry
Note	Dia.	Weight							
		Cwts.	Lbs.	Cwts.	Lbs.	Cwts.	Lbs.	Feet	Feet
A	75″	83	9296	411	46032	709	79408	19	28
G♯	80″	100	11200	487	54544	840	94080	20	30
G	84″	115	12880	574	64288				
F♯	89″	140	15680	686	76832				

* The combined weights of the Bells, Frame, and Fittings, as shown above, give the total load to be supported in the Belfry; the weights of the clavier and any operating mechanism supplied vary with each installation but are negligible as far as the strength of the tower is concerned.
The figures given for the span and height of the Belfry are the minimum for a standard layout; any extra space that can be allowed is advantageous as providing more room for access and inspection, but on the other hand the arrangement of the bells can be specially planned to suit smaller spaces where necessary.

Weights of Chimes

Eight Bells.

BASS BELL				Total Weight of Bells		* Total Weight of Bells Frame and Fittings		Minimum Span of Belfry	Minimum Height of Belfry
Note	Dia.	Weight		Cwts.	Lbs.	Cwts.	Lbs.	Feet	Feet
		Cwts.	Lbs.						
C	31¼"	6	672	25½	2856	52	5824	9	11
A	37½"	10	1120	38½	4312	77	8624	10	11
G	42"	14½	1624	52½	5880	103	11536	11	12
F	47"	20	2240	72	8064	137	15344	12	12
E	50"	25	2800	86	9632	162	18144	13	13
D	56"	34	3808	118	13216	219	24528	14	14
C	63"	48½	5432	165	18480	301	33712	15	15

Ten Bells, Diatonic. (Example:—C D E F G A B C D E).

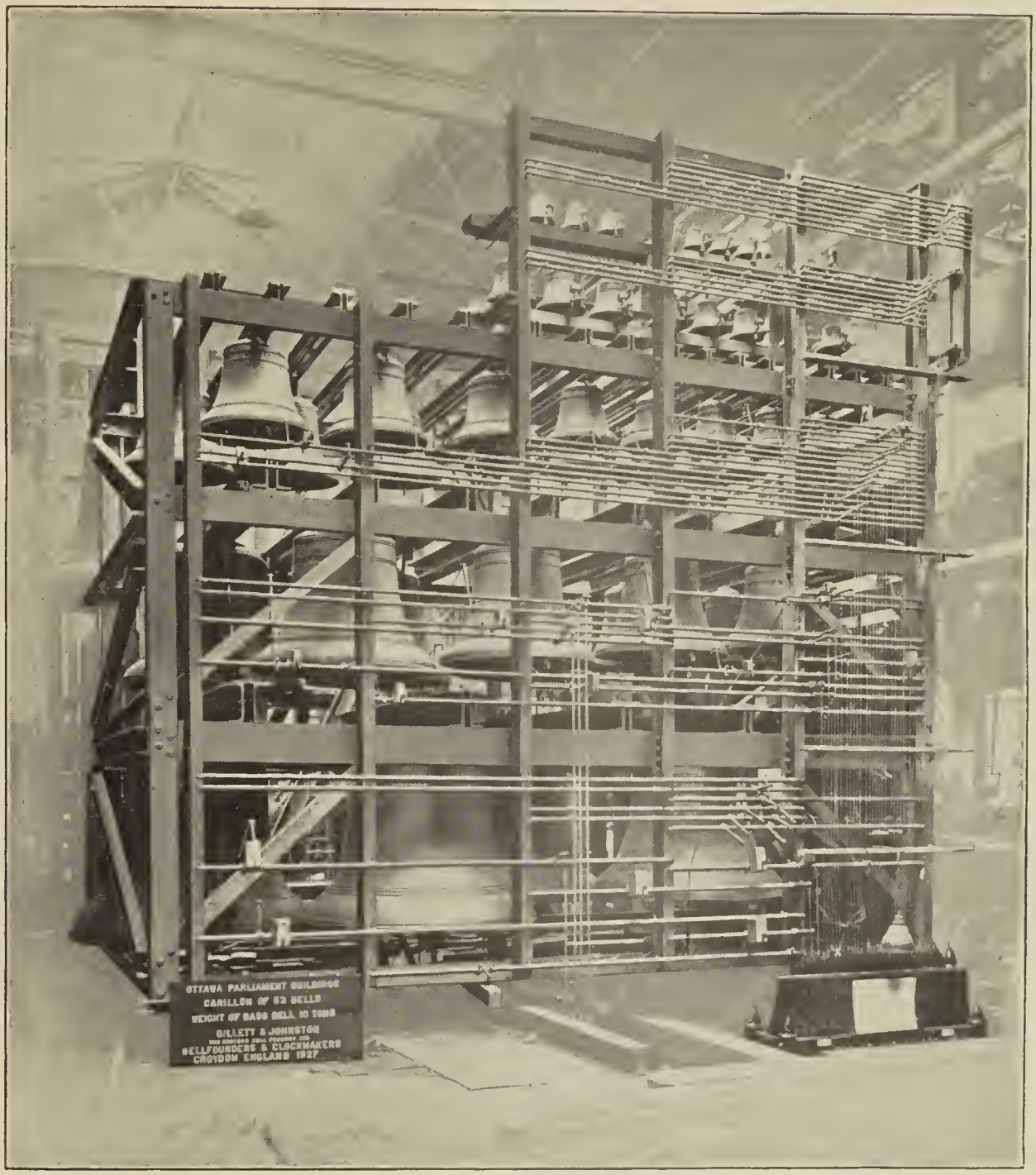
C	31¼"	6	672	27	3024	56	6272	9	12
A	37½"	10	1120	41	4592	82	9184	10	12
G	42"	14½	1624	55½	6216	109	12208	11	13
F	47"	20	2240	75½	8456	145	16240	12	13
E	50"	25	2800	91	10192	171	19152	13	14
D	56"	34	3808	126	14112	232	25984	14	15
C	63"	48½	5432	175	19600	317	35504	15	16

Fourteen Bells. (Example:—C D E F F♯ G A A♯ B C D E F G).

A	37½	10	1120	50	5600	99	11088	10	13
G	42"	14½	1624	67	7504	130	14560	11	14
F	47"	20	2240	90	10080	173	19376	12	14
E	50"	25	2800	107	11984	202	22624	13	15
D	56"	34	3808	148	16576	274	30688	14	16
C	63"	48½	5432	206	23072	374	41888	15	17

* The combined weights of the Bells, Frame, and Fittings, as shown above, give the total load to be supported in the Belfry; the weights of the clavier and any operating mechanism supplied vary with each installation but are negligible as far as the strength of the tower is concerned.

The figures given for the span and height of the Belfry are the minimum for a standard layout; any extra space that can be allowed is advantageous as providing more room for access and inspection, but on the other hand the arrangement of bells can be specially planned to suit the smaller spaces where necessary.



Upper Framework, Ottawa Parliament Buildings

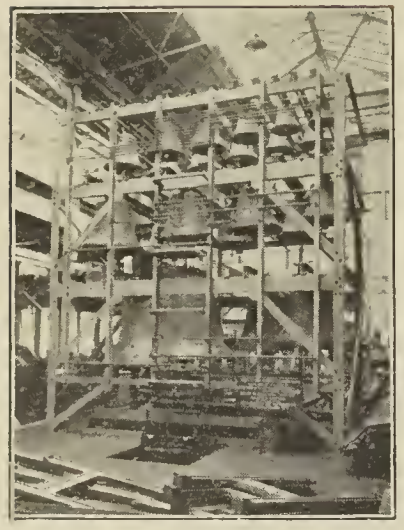
Steel Framework for Carillons

WE hang our carillon bells in self-contained steel cages requiring only two main girders spanning the tower to support the four upright corner posts.

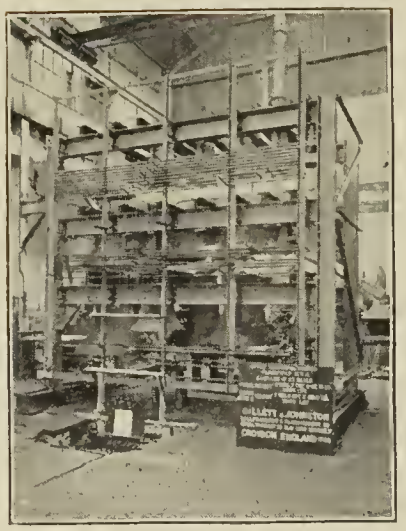
The mass of bells and framework constitutes a dead load, and no vibration or oscillation is imparted to the walls of the tower.

The rollers and cranks operating the clappers are on one side of the frame, allowing for easy access for oiling pivots, adjusting wires, etc.

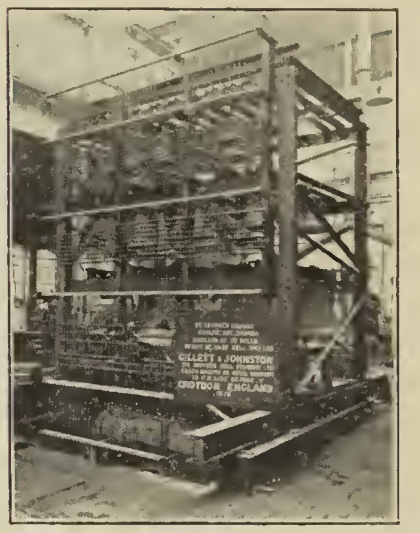
All bells but the smallest are provided with individual steel supporting beams placed in line with the blow of the clapper, to eliminate the tendency of the bell to swing when struck rapidly.



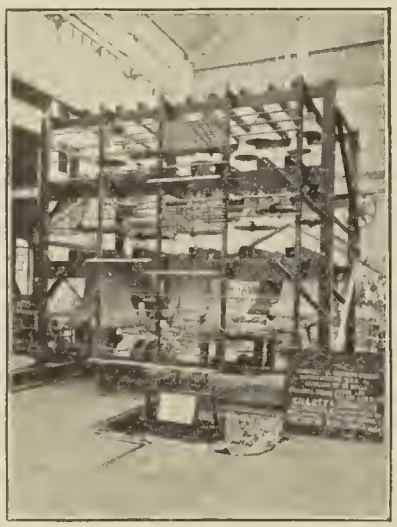
St. Stephen's Church,
Cohasset, Mass.



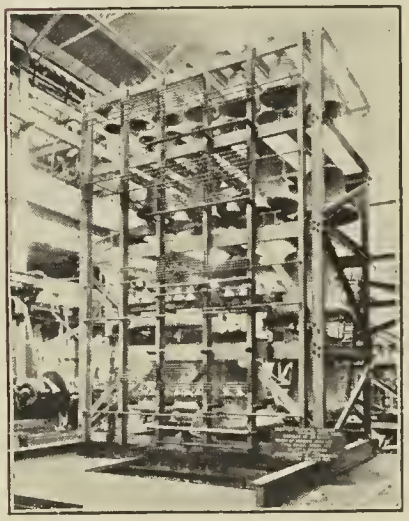
Grace Church,
Plainfield, N.J.



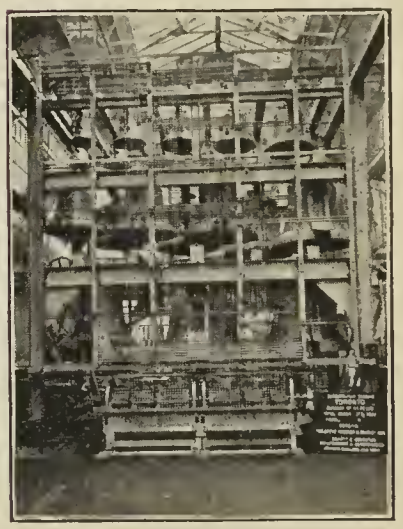
St. George's Church,
Guelph, Ont.



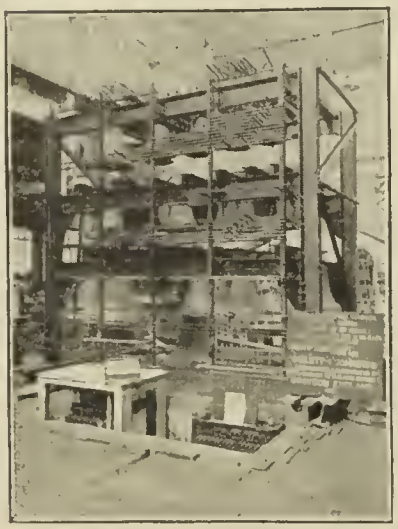
Mayo Clinic,
Rochester, Minn.



Municipal Buildings,
Norwood, Mass.

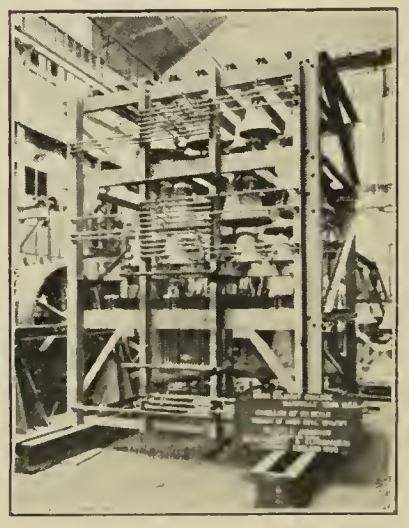


Metropolitan Church,
Toronto.



Memorial Tower,
Simcoe, Ont.

Jefferson Avenue Church,
Detroit, Mich.



Ward Belmont School,
Nashville, Tenn.

Electro-Pneumatic Operation of Carillons

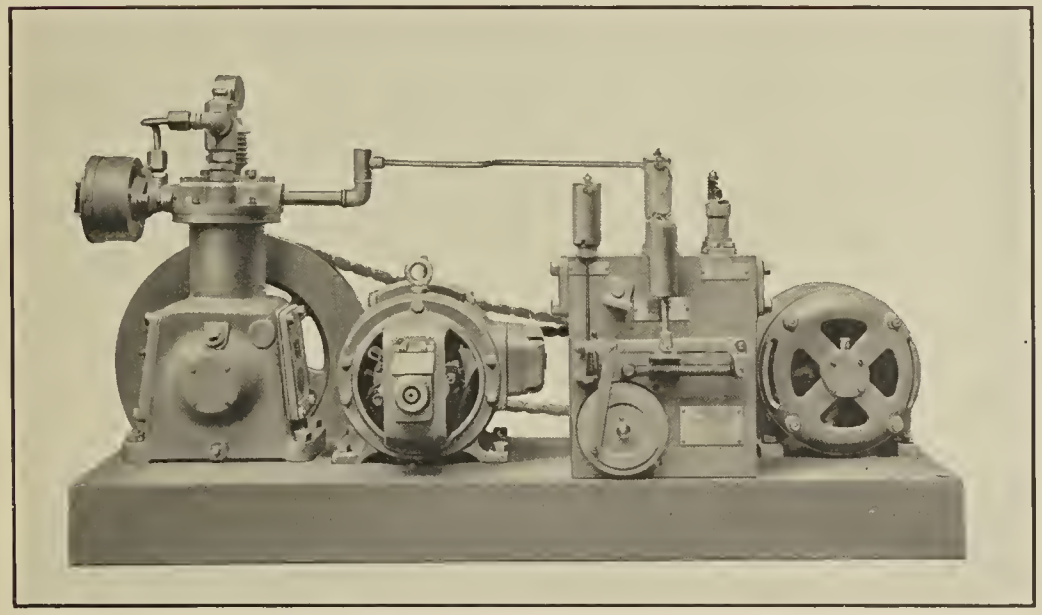


Fig. 1. Power Plant

MECHANICAL Operation of the carillon is an advantage where the services of a skilled carillonneur to play on the hand clavier are not always obtainable. Mechanical playing, though crisp and accurate, and bringing out a full volume of sound from each bell, does not lend itself to expression and modulation of tone. It is, however, of great value as an addition to the carillon; the ivory keyboard is easy to play on and it does not require the skilled manipulation of the clavier leavers, while the automatic paper-band player needs no skill whatever, being started by push button or clockwork release. The mechanical action can also be adjusted, if required, to give blows of greater carrying power than those obtainable by hand.

Assisted by experience extending over fifty years in the manufacture of automatic machines for playing carillons, we have evolved and patented a system of electro-pneumatic operation which meets all modern requirements. and which is suitable to the severe climatic conditions usual in belfry towers.

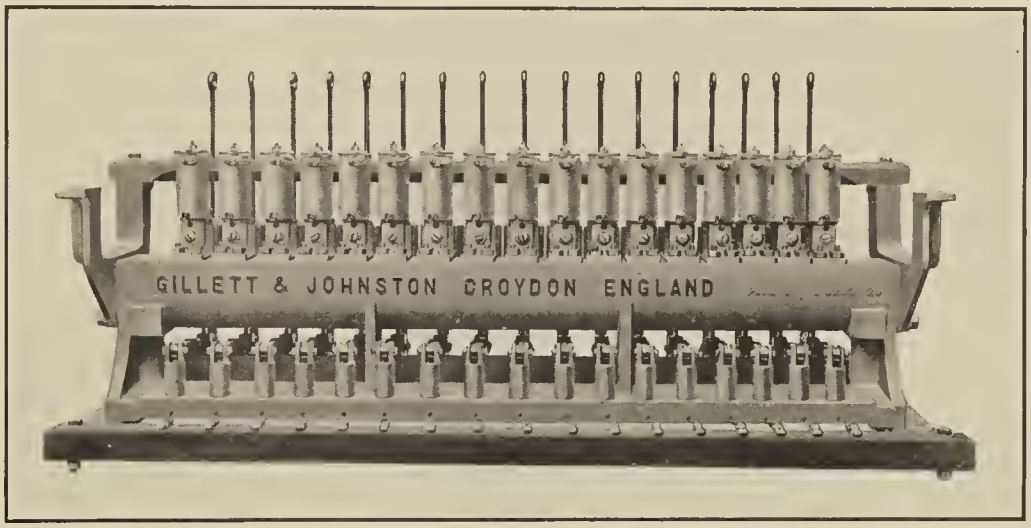


Fig. 2. Pistons (Small)

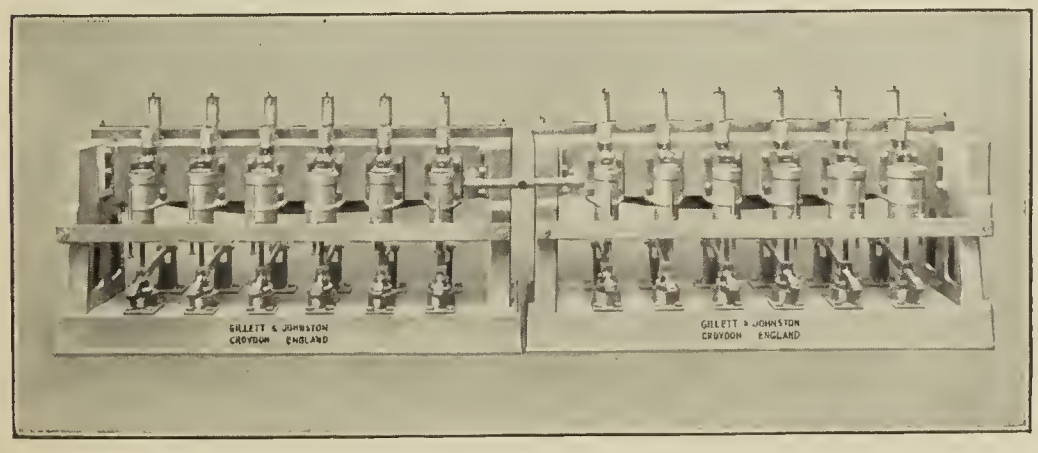


Fig. 3. Pistons (Large)

Compressed air at low pressure, acting on pistons, is used to give the actual blow, and low voltage direct current to provide the connections between the keyboard, or automatic player and the air valves of the pistons. No special or delicate mechanism is involved and there is no risk of the attendant receiving an electric shock, while highly skilled supervision is not necessary.

Fig. 4. Ivory Keyboard

The Power Plant, Fig. 1, usually placed in the clavier chamber, consists of a cast iron base plate on which is mounted a standard motor, wound to suit the local electric supply; a generator, producing direct current at 25 volts; an air cooled compressor, delivering air at 25 lbs. per square inch, and the firm's Remote Control unit for starting and stopping. The pistons and cylinders are arranged in gangs and are proportioned to the size of the bells operated; Fig. 2 shows a group of the smaller sizes and Fig. 3 a group of the larger sizes. Each piston has an air valve operated by an enclosed solenoid, these latter being interchangeable and secured by bayonet-joint fastenings. The cylinders are mounted on air receiver bases and the complete units are placed in the room immediately under the belfry and are attached, by means of a series of standard rollers and cranks, to special clappers striking on the opposite side of the bell to the clappers attached to the clavier. In this way it is possible to obtain the best results from both methods of operation, the mechanically operated clappers being adjusted to give full blows of good carrying power and the clavier clappers adjusted to suit the more delicate manipulation by the carillonneur.

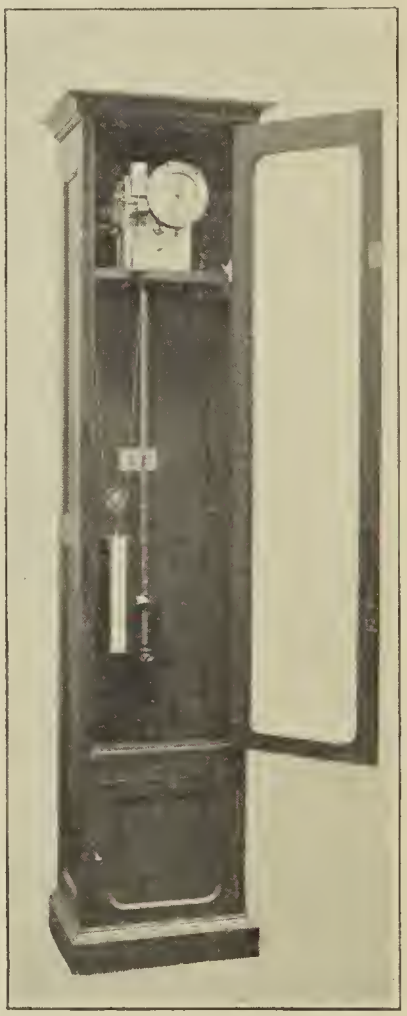


Fig. 5. Clock

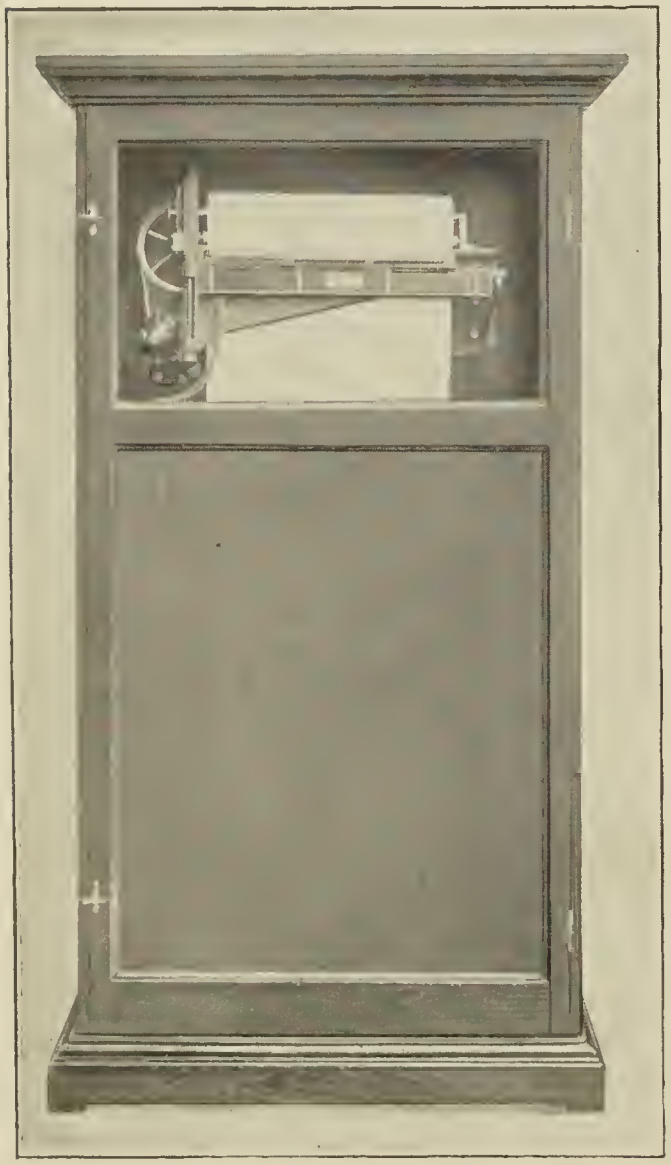
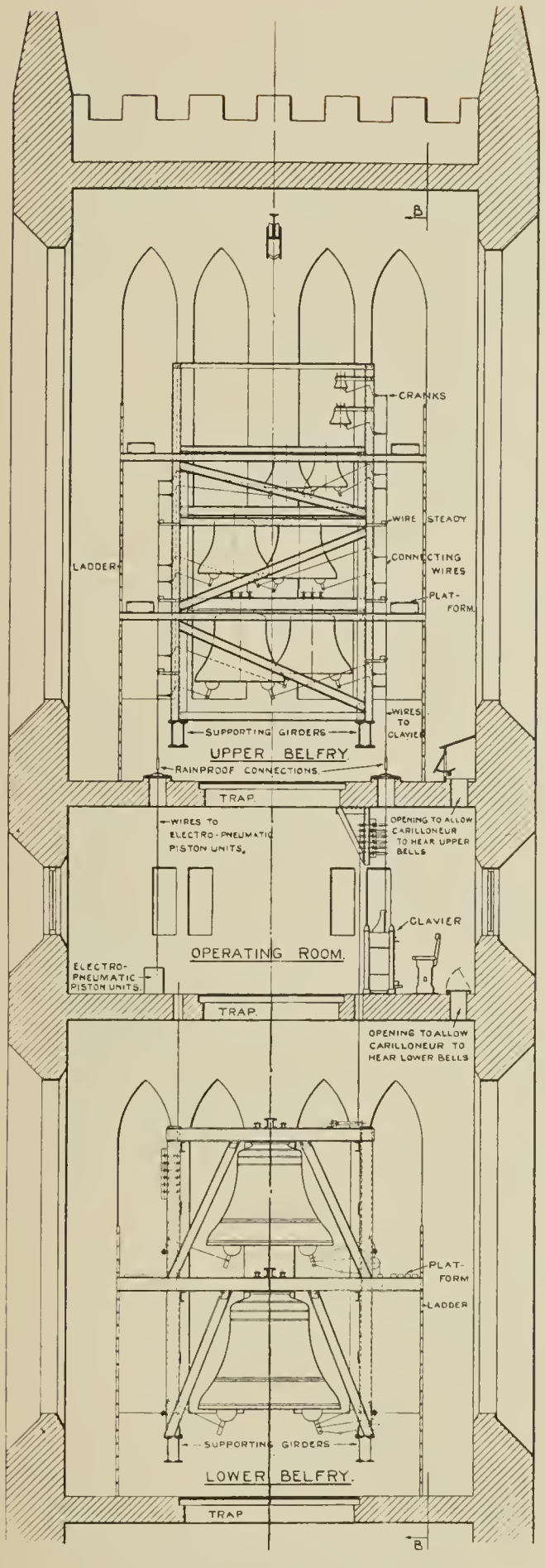


Fig. 6. Automatic Player

Fig. 4 shows a standard ivory keyboard; this has practically the same touch as an organ, and on a key being depressed the 25 volt circuit is closed and operates the solenoid on the corresponding piston and cylinder. The keyboard can be fixed at any distance from the tower. The automatic player, Fig. 6, has interchangeable paper bands perforated by the firm's special machinery in accordance with the music desired. It can be started either by push button or by the 8-day timepiece, Fig. 5.

As a typical example of one of these installations, the carillon of 23 bells at the Mayo Clinic, Rochester, Minnesota, is equipped with a clavier for special recitals, an automatic paper band player started by clockwork three times a day, and an ivory keyboard to enable any local musician to play special airs on the bells in the absence of a skilled carillonneur.

¶ *As the whole of this mechanism has been designed and patented by Gillett & Johnston, and is manufactured by them at Croydon, they are in the position to undertake undivided responsibility for the complete equipment of a carillon tower.*



SECTIONAL ELEVATION ON A-A

Carillons.

Arrangement of the Bells and Operating Mechanism in the Tower

General Requirements.

Maximum possible height of belfry from the ground.

Maximum possible area of openings in the sides of the belfry for sound distribution.

The openings to extend for as great a distance as possible above the bells.

Louvres can be built into the openings for architectural reasons but the bells are heard better without them.

Traps should be arranged in each floor down to the ground for hoisting; this reduces both the cost of erection and the cost of adding extra and heavier bells in the future.

A beam for hoisting is required at the top of the upper belfry.

The operating room, with 12 ft. headroom, must be immediately below the upper belfry floor.

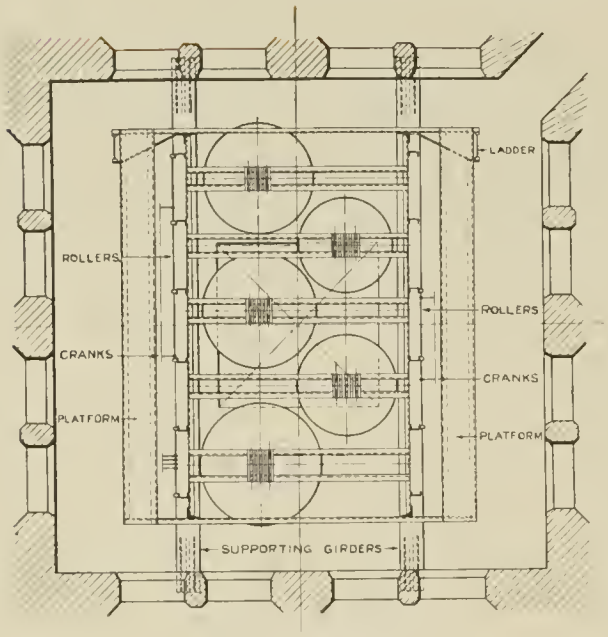
.....

Carillons in which the Bourdon or heaviest bell does not weigh more than 9296 lbs. (4 tons 3 cwts. note A, 75" diameter) are usually placed in a single chamber such as the upper belfry illustrated, and are played from the operating room below. The clavier must be as near the upper bellframe as possible, as short wire connections improve the touch on the keys.

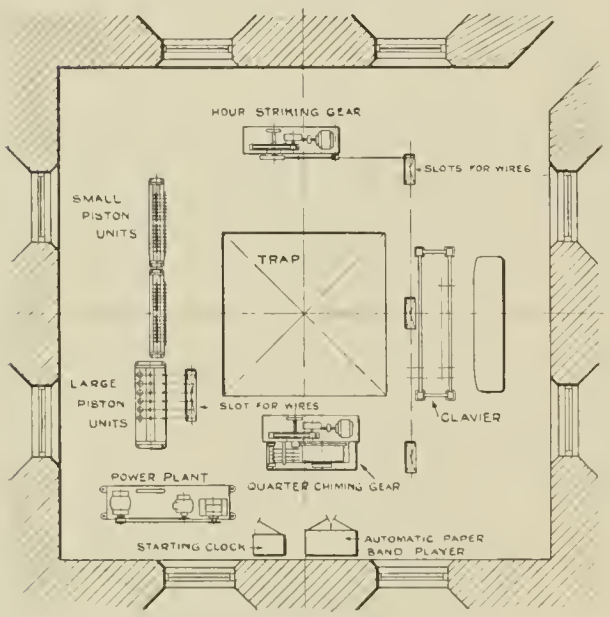
When there are still heavier bells in the carillon these can be arranged to advantage in a lower belfry as shown, supported in framework designed to suit the greater weight of metal.

When a swinging Bourdon is required this should be placed by itself in the centre of a chamber immediately below the lower belfry.

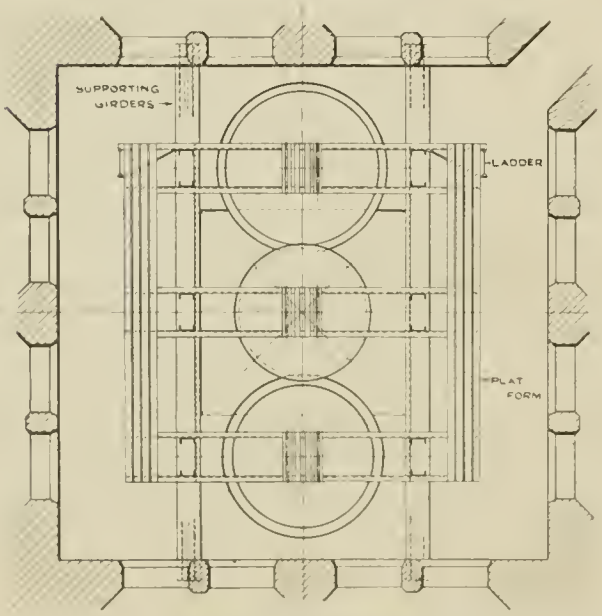
Arrangement of Carillons *(continued)*



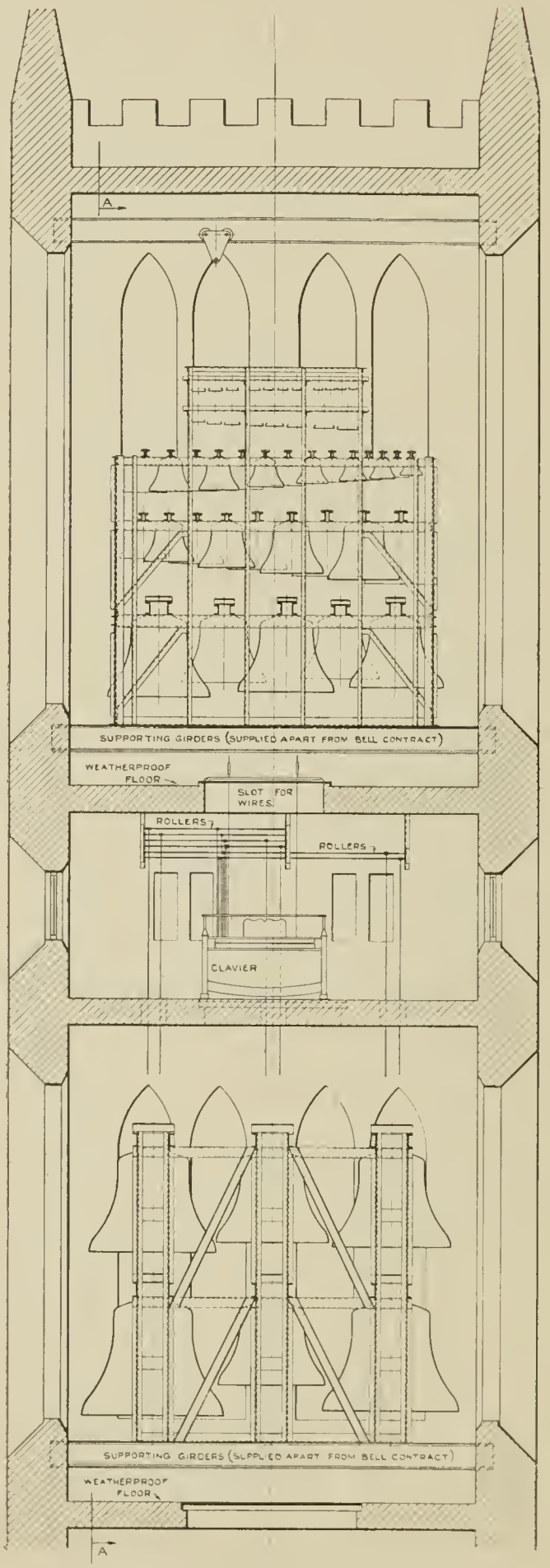
PLAN OF UPPER BELFRY.



PLAN OF OPERATING ROOM



PLAN OF LOWER BELFRY



SECTIONAL ELEVATION ON B-B

Architects: Messrs. Henry C. Pelton & Allen & Collens

Riverside Drive Church, New York City, N.Y.

(The Laura Spelman Rockefeller Memorial Carillon)

No. of Bells	72
Weight of Bourdon (Note C)	18¼ tons (40,880 lbs.)
Diameter of Bourdon	122 inches
Total weight of Bells	102 tons
Height of Tower	387 feet

CLOCK: Quarter Chimes on ten bells, Hours Struck on Bourdon.

¶ *THE LARGEST CARILLON AND CLOCK IN THE WORLD: the entire installation, including electro-pneumatic operating mechanism on the larger bells, was manufactured at Croydon, by Gillett & Johnston.*

Architects : Messrs. Smith, Hinchman & Grylls

Jefferson Avenue Presbyterian Church, Detroit

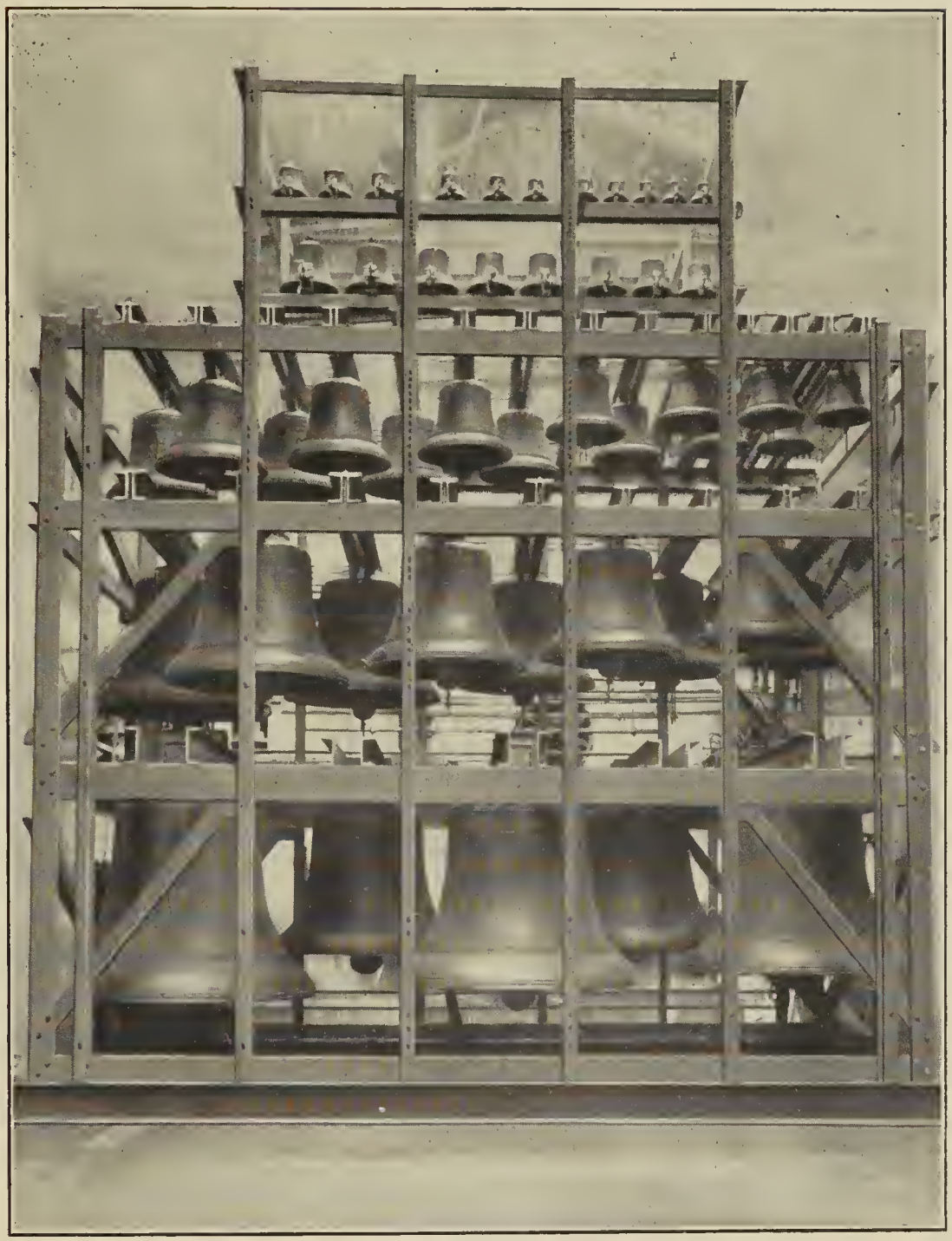
No. of Bells	...	...	23
Weight of Bourdon (Note E)	...	...	20½ cwts. (2,296 lbs.)
Total Weight of Bells	...	...	5 tons 8 cwts. (12,096 lbs.)

Operated by Clavier.

Inscription on Bourdon :

"This Chime of Bells was presented to the
Jefferson Avenue Presbyterian Church, Detroit,
In loving memory of Henry Russel,
by his wife, Eleanor T. Russel, A.D. 1924."

¶ *The entire installation, including the bells, steel framework and operating gear, was manufactured at Croydon by Gillett & Johnston.*



Upper Section of the Carillon showing the Bells in the Frame

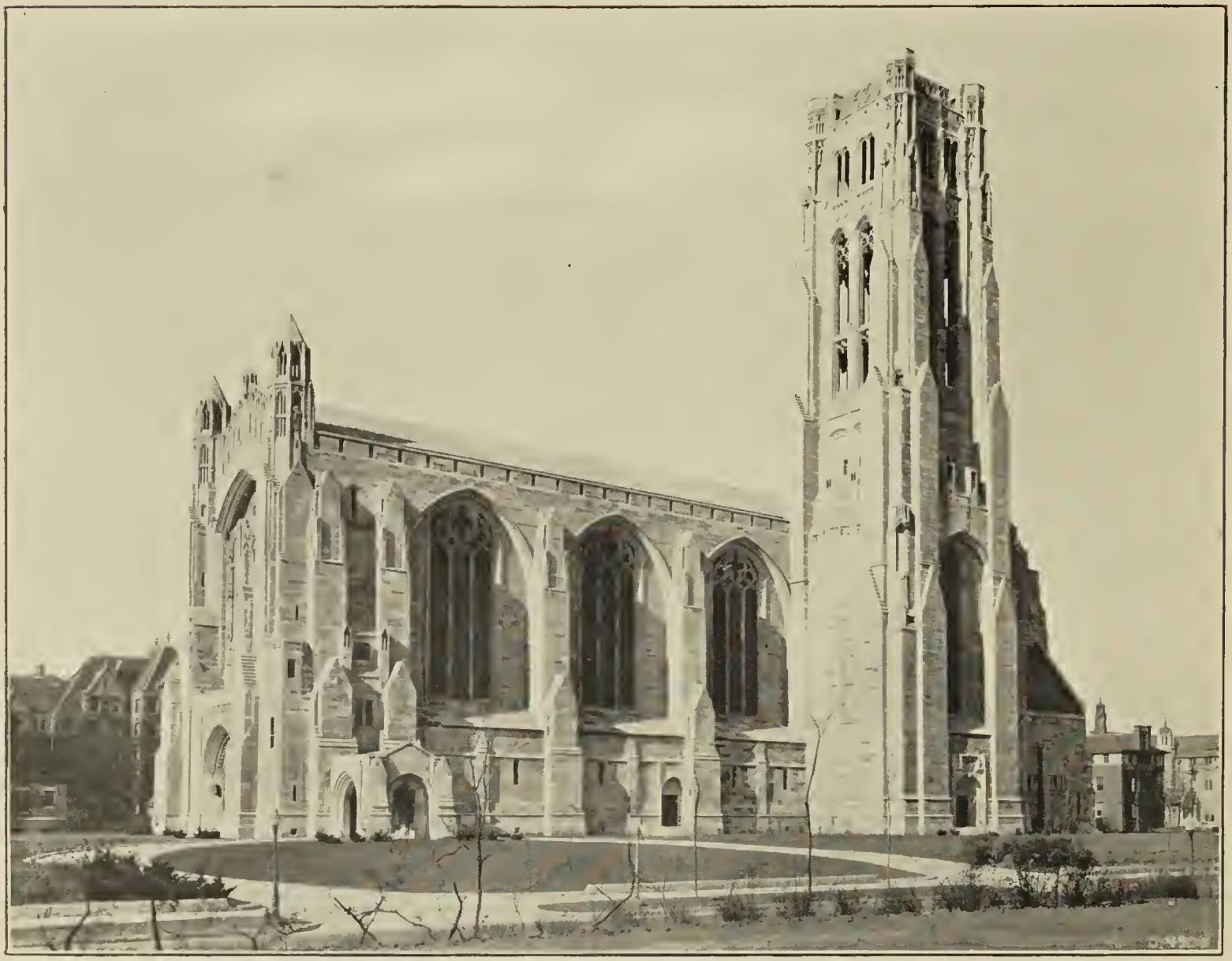
Wellington (N.Z.)

War Memorial Carillon

No. of Bells in Carillon	...	...	49
Weight of Bourdon	...	...	5 tons (11,200 lbs.)
Total Weight of Bells	...	...	31½ tons (70,560 lbs.)

Operated by Clavier, also by the Firm's patented Electro-pneumatic mechanism, including ivory key-board for remote control, and Paper Band Automatic Player, the latter started as required by a Master Timepiece.

¶ *The entire installation, including the bells, steel framework, electro-pneumatic operating mechanism and the clock mechanism was manufactured at Croydon by Gillett & Johnston.*



Architects : Bertram Grosvenor Goodhue Associates, New York, U.S.A.

The University of Chicago

The Chapel

No. of Bells	...	...	64
Weight of Bourdon (Note C♯)		...	17 tons (38,080 lbs.)
Total Weight of Bells	...	...	92 tons (206,080 lbs.)

Five Bells are hung to swing, Low C♯, F♯, G♯, A♯ and C♯.

The largest sixteen bells have Electro-pneumatic Assistance.

The Hours are struck on the Bourdon, and the Quarters are chimed on ten bells, diatonic scale, Low F♯ to A♯.

(Contract for the complete installation placed with Gillett & Johnston, March, 1929.)

Ottawa
Parliament Buildings

Victory Tower

Dedicated July, 1927

CARILLON:

No. of Bells	53
Weight of Bourdon (note E)	10 tons (22,400 lbs.)
Total Weight of Bells ...	53 tons (118,720 lbs.)
Diameter of Bourdon ...	100 inches
Height of Tower	280 feet

CLOCK:

"Westminster" Quarters on four bells.
Hours struck on Bourdon.

DIALS:

Four, each 15 feet 9 inches diameter, electrically operated.

Inscriptions on Bourdon Bell:

"This Carillon was installed by authority of Parliament, to commemorate the Peace of 1919 and to keep in remembrance the service and sacrifice of Canada in the Great War

Anno Domini MCMXXVI.

Glory to God in the Highest
And on earth peace
Good will toward men

St. Luke's Gospel, chapter ii, verse 14"

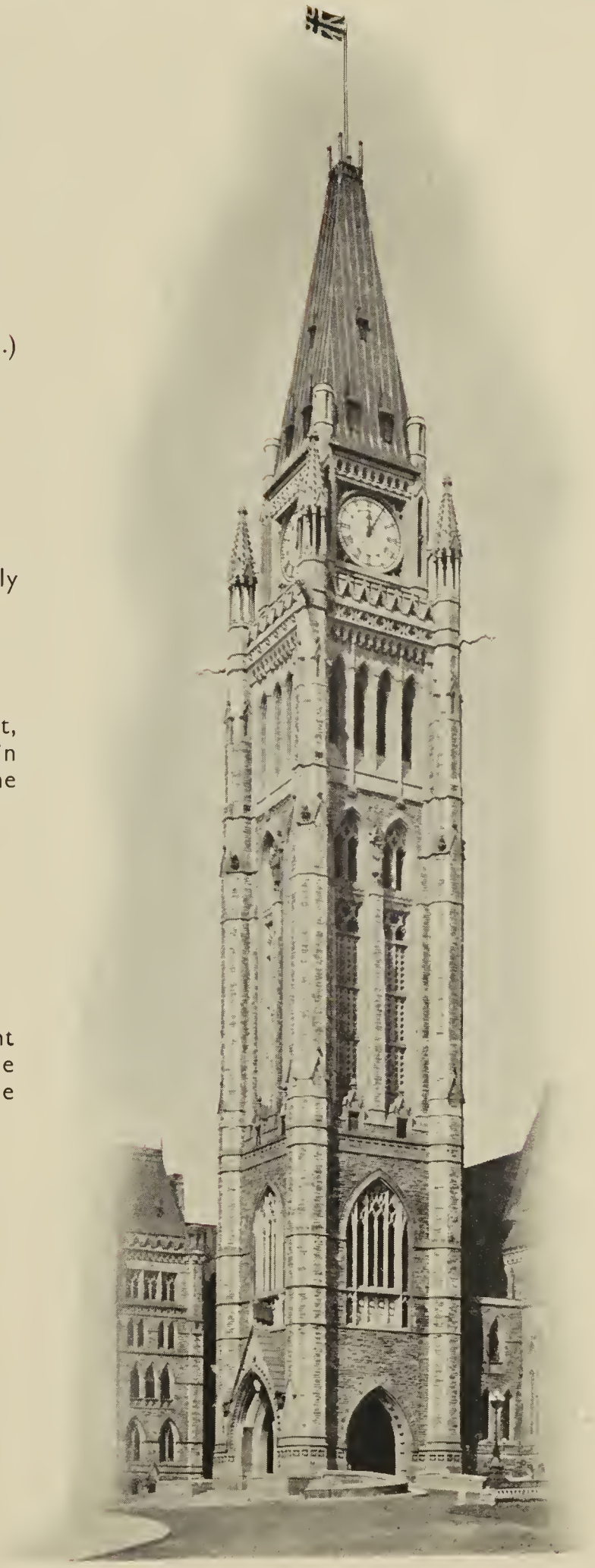
"Ce Carillon a été installé par ordre du Parlement pour commémorer la Paix de 1919 et perpétuer le souvenir des sacrifices du Canada et des exploits de ses fils pendant la Grande Guerre

Anno Domini MCMXXVI.

Gloire à Dieu au plus haut des Cieux
Et paix sur la terre
Aux hommes de bonne volonté

Evangile selon saint Luc, chapitre ii, verset 14."

¶ *The entire installation, including the bells, steel framework, electro-pneumatic operating mechanism, and the clock mechanism were manufactured at Croydon by Gillett & Johnston.*



Architects : Ellerbe & Company, Saint Paul, Minn.

Mayo Clinic, Rochester, Minn., U.S.A.

Dedicated September, 1928

No. of Bells in Carillon	23
Weight of Bourdon (Note A)	3 tons 8 cwts. (76,161 lbs.)
Total Weight of Bells	17 tons (38,080 lbs.)

Operated by Clavier, and also by the firm's patented electro-pneumatic mechanism, including ivory keyboard and paper band automatic player, the latter started as required by a master timepiece.

Inscription on Bourdon Bell :

" Dedicated to the American Soldier
by William J. and Charles H. Mayo."

¶ *The entire installation, including the bells, steel framework, electro-pneumatic operating mechanism and the clock mechanism was manufactured at Croydon by Gillett & Johnston.*

Architect : Ralph Adams Cram

Princeton University, N.J , U.S.A.

Cleveland Tower

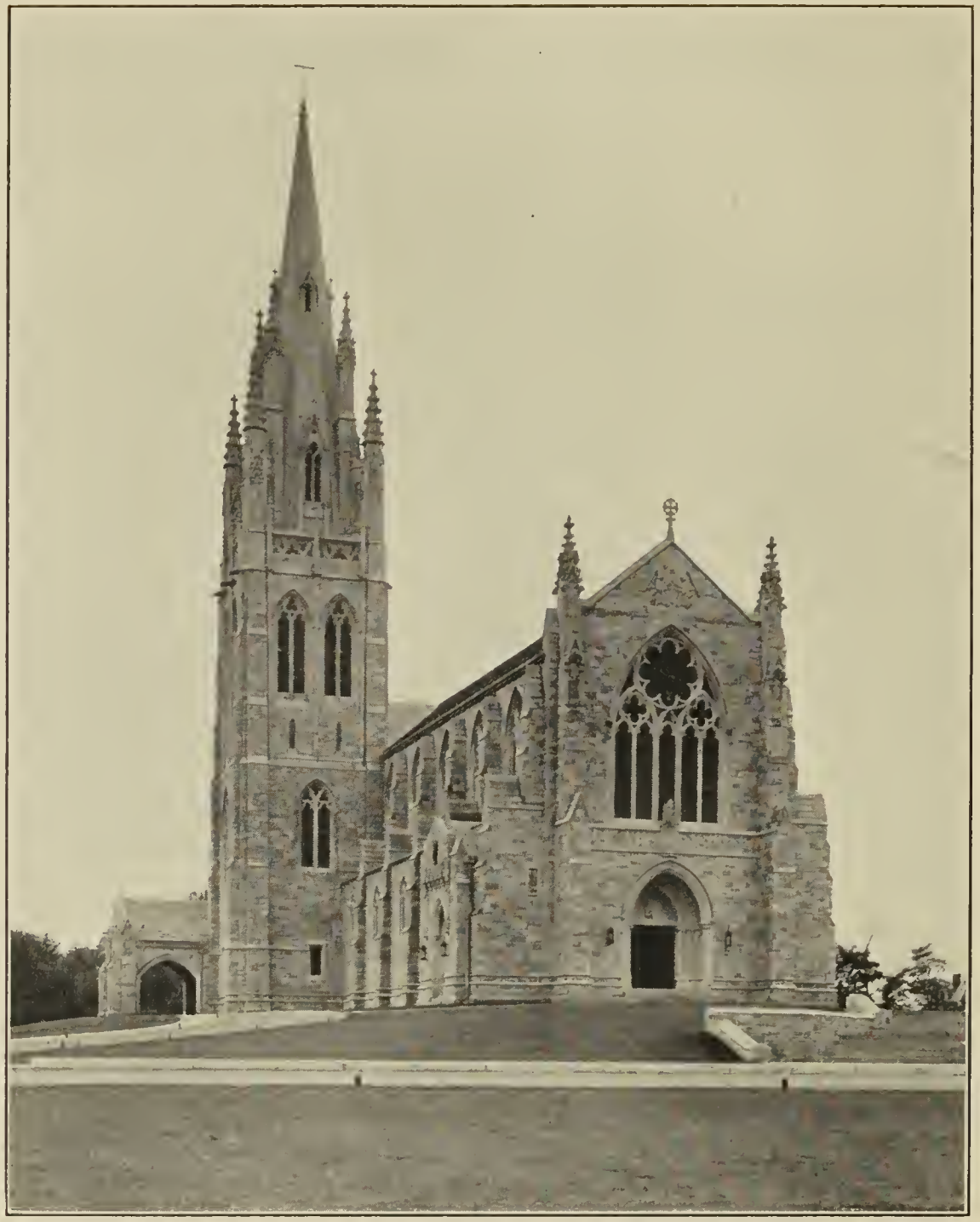
No. of Bells in Carillon	...	...	...	35
Weight of Bourdon (Note G)	...	...	...	5¾ tons (12,880 lbs.)
Diameter of Bourdon	...	...	...	84 inches
Total Weight of Bells	...	...	...	30 tons (67,200 lbs.)

Operated by Clavier, and by electro-pneumatic mechanism controlled by a paper band automatic player, the latter released by clockwork.

Inscription on Bourdon :

"Dei Sub Numine Viget
Presented to Princeton University
with love and gratitude
by the Class of 1892
June, 1927."

¶ *The entire installation, including the bells, steel framework, electro-pneumatic operating mechanism and the clock mechanism was manufactured at Croydon by Gillett & Johnston.*



Architect: Ralph Adams Cram

The Chapel, Mercersburg Academy, Pa., U.S.A.

No. of Bells	43
Weight of Bourdon (Note A sharp)	$3\frac{1}{4}$ tons (7,280 lbs.)

Operated by Clavier. The steel framework is arranged with spaces for four extra bells, the future Bourdon to weigh $5\frac{3}{4}$ tons (12880 lbs).

Inscription on Bourdon:

"ROLAND
To the Glory of God,
This Carillon is the Gift of Henry Bucher Swoope, Class of 1900, and his Family,"

¶ *The entire installation, including the bells, steel framework and operating mechanism was manufactured at Croydon by Gillett & Johnston.*

Architect: Ralph Adams Cram

St. Stephen's Church, Cohasset, Mass.

No. of Bells in Carillon	51
Weight of Bourdon (Note G)	5 tons (11,200 lbs.)
Diameter of Bourdon	81 inches
Total Weight of Bells	28½ tons (63,840 lbs.)

Operated by Clavier.

Inscription on Bourdon:

"To the Glory of God and in Loving Memory of
Jessie M. Barron, 1851—1918
O Ye spirits and souls of the righteous, bless ye the Lord;
praise Him and magnify Him forever."

St. Stephen's Church, Cohasset, Mass.—(*continued*)

Thousands of people come from all parts of America to listen to the Carillon Recitals at Cohasset

THE Carillon (originally 23 bells) was donated by Mrs. Hugh Bancroft, in memory of her mother, Jessie M. Barron (Mrs. Clarence W.), and was dedicated in September, 1924.

In 1925, Mrs. Bancroft added 20 bells, and in 1928 eight more were installed. The Carillon of 51 bells is now one of the largest in the world. The Reverend Charles C, Wilson, Rector of St. Stephen's Church, says:

> "It is difficult to over-estimate the value of this memorial to Cohasset, the church and community . . . . . The Carillon is a perfect memorial."

Architects: Sproatt & Rolph, Toronto.

Toronto University
Alumni Memorial Carillon

No. of Bells	23
Weight of Bourdon (Note A♭)	3½ tons (7,840 lbs.)
Operation by Clavier	

Dedicated: October, 1927.

¶ *The clock has two bronze dials 13' 0" diameter and strikes the hours on the Bourdon Bell. The entire installation, including the bells, steel framework and the clock and dials, was manufactured at Croydon by Gillett & Johnston.*

Mariemont, Ohio

The Mary M. Emery Memorial Carillon

Architects: Stanley Matthews, Chas. W. Short.

No. of Bells	23
Weight of Bourdon	42½ cwts. (4,760 lbs.)
Note ,, ,, ...	C♯
Operation by Clavier	

Inscription on Bourdon:

Dedicated to the Youth of Mariemont
in Memory of its Founder, my beloved
Sister, Mary Muhlenberg Emery,
A.D. 1929
Isabella F. Hopkins.

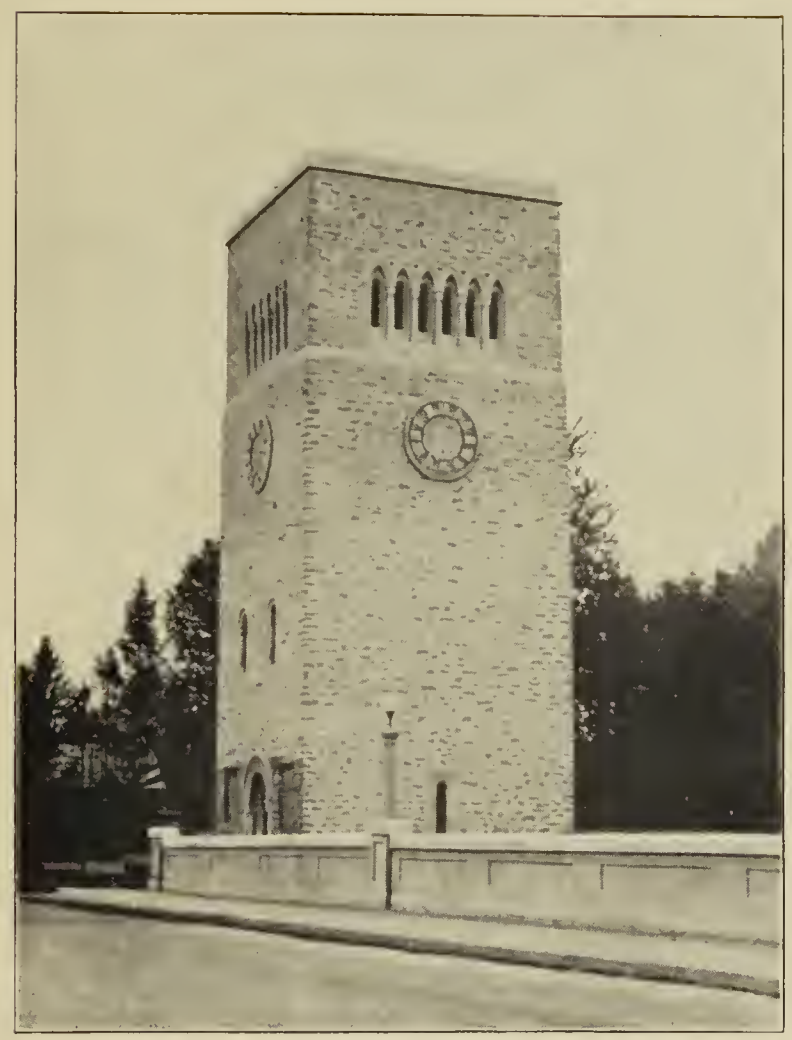
Dedicated Nov. 16th, 1929, by the
Rev. Boyd Vincent and the
Rev. Frank H. Nelson.

The Tower has a Bedford Stone facing on a skeleton of re-inforced concrete and rises 96 feet from the ground from a small enclosing terrace. The Vestibule is lined with the same stone as the interior and leads into two of the corner bastions, one containing an electric elevator to the clavier room, the other a circular staircase to the observation platform on the top, which is guarded by a solid high parapet wall.

The bells are open to the weather and can be seen through the stonework tracery of the belfry.

The tower has been purposely placed in a setting of trees so that it may be seen to the best advantage in glimpses through a screen of foliage or backed by the dense green of the trees in Dogwood Park.

The Carillon was manufactured and the Tower built under the direction of Mr. Chas. J. Livingood.



The Bell Tower
Architects: Sproatt & Rolph, Toronto

Simcoe, Ont., Canada

The Norfolk Soldiers' War Memorial Carillon,
Erected 1924.

No of Bells 23
Weight of Bourdon (note F) 14 cwts. (1,568 lbs.)

Carillon operated by clavier and by electro-pneumatic paper band player.

Westminster Quarter Clock with four 7′ 0″ diameter dials.

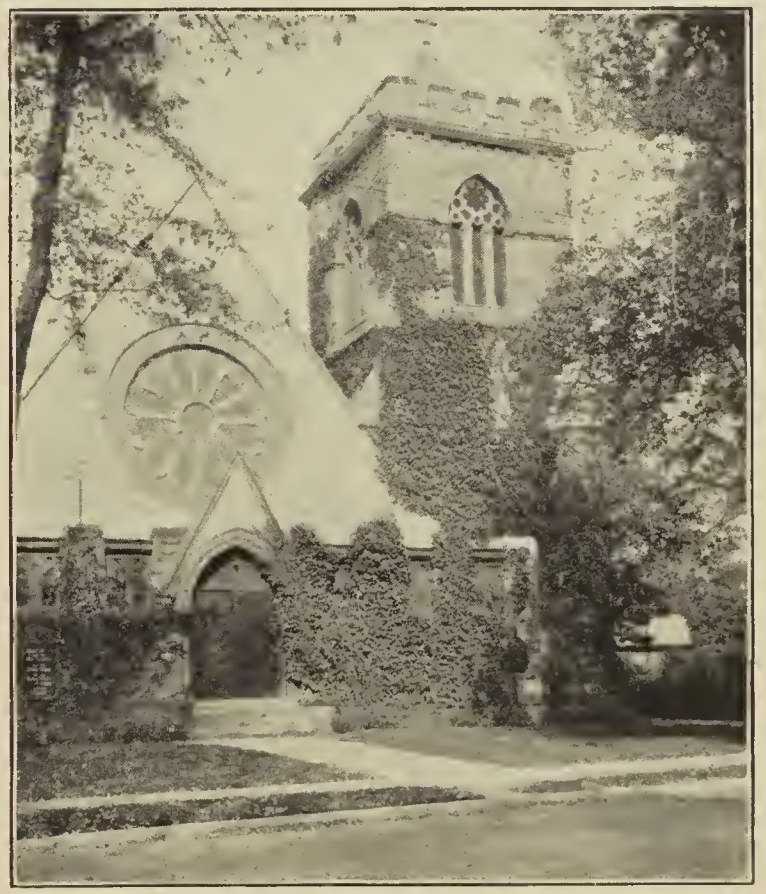
This Carillon, with the automatic playing mechanism, was exhibited throughout the Summer of 1924 at the British Empire Exhibition, Wembley.

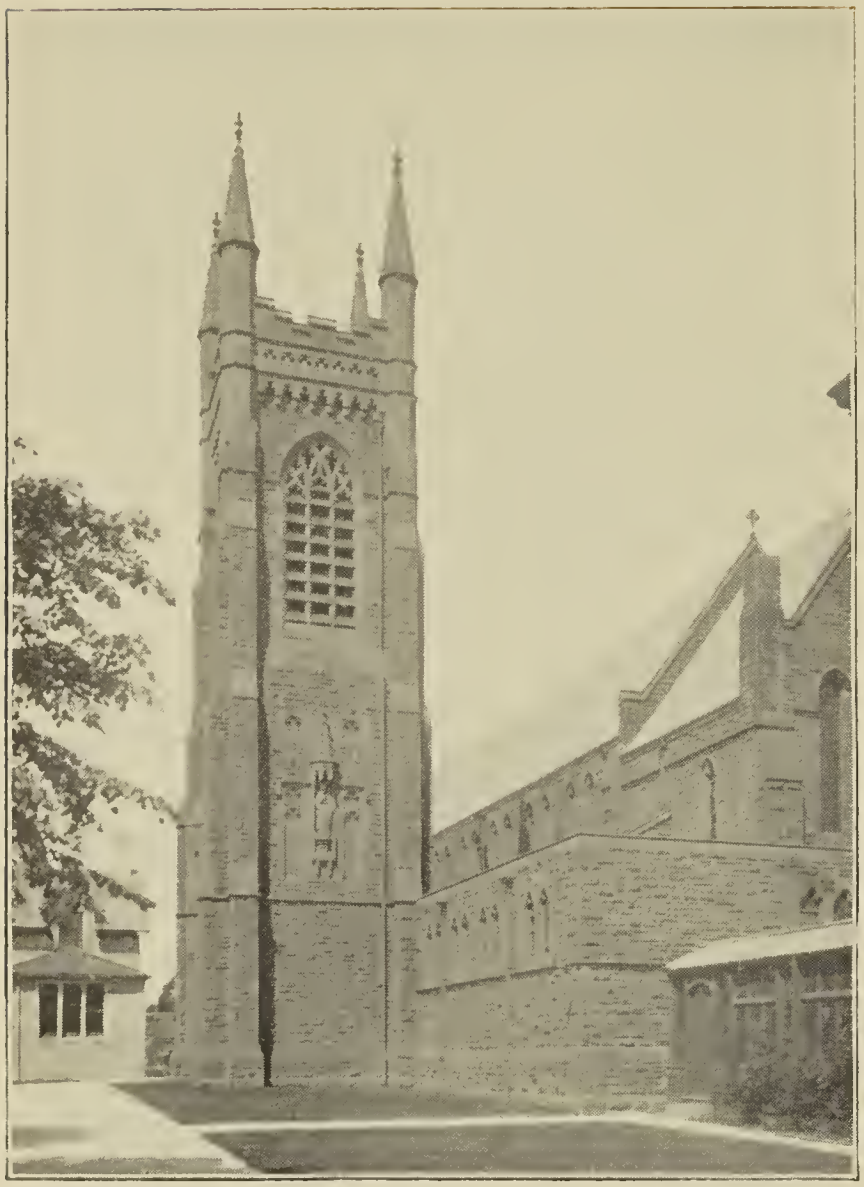
Grace Church, Plainfield, N.J., U.S.A.

The Carillon of 23 bells, the gift of Dr. Albert Pittis, was placed in the tower in 1923.

The Bourdon (Note E), 48″ diameter, weighs 20½ cwts. (2,296 lbs.)

Operated by clavier.





Architects : Pugin & Pugin, Liverpool

St. Patrick's Church, Dumbarton (Scotland)

Dedicated December, 1928.

No. of Bells in Carillon 23
Weight of Bourdon (note F♯) 17 cwts. (1904 lbs.)
Clock : " Ting Tang " Quarters and Hours.

An extra bell, weighing 19¾ cwts. (2,214 lbs.) (note F), is built into the Carillon framework and arranged to swing.

Inscription on Ringing Bell :

D.O.M.

Ad honorem S. Patricii Hibernæ Apost. Tit, hujus Ecclesiæ qui in hac Regione primo lucem videbat

Feliciter Regnante Pic PP. XI.

Procurante Revmo. Dom, Hugone Canonico Kelly Hanc Campanum

Illmus. and Revmus. Dom. Dom. Donaldus Mackintosh

Archiepiscopus Glasguensis

Benedixit et Consecravit

Die 17 Memsis Martii M.C.M. XXVII.
Et Verbum Caro Factum Est

(On either side of the above are the Papal Arms and the Bishop's Arms).

(On reverse side

Laudo Deum Verum, Plebum voco, Congrego Clerum

Defunctus ploro, nubem fugo, Festa decoro.

Inscription on Bourdon Bell of Carillon :

Ad Honorem Beatæ Virginis Mariæ
Tota Pulchra es Maria
Et Macula Originalis
Non Est In Te
Ex Campanis Ecclesiæ S. Patricii Dumbarton

¶ *The entire installation, including the bells, steel framework and operating mechanism, was manufactured at Croydon by Gillett and Johnston.*

The Bell Turret Illuminated *Architect : E. Vincent Harris*

Messrs. Atkinson, Ltd., Bond Street, London

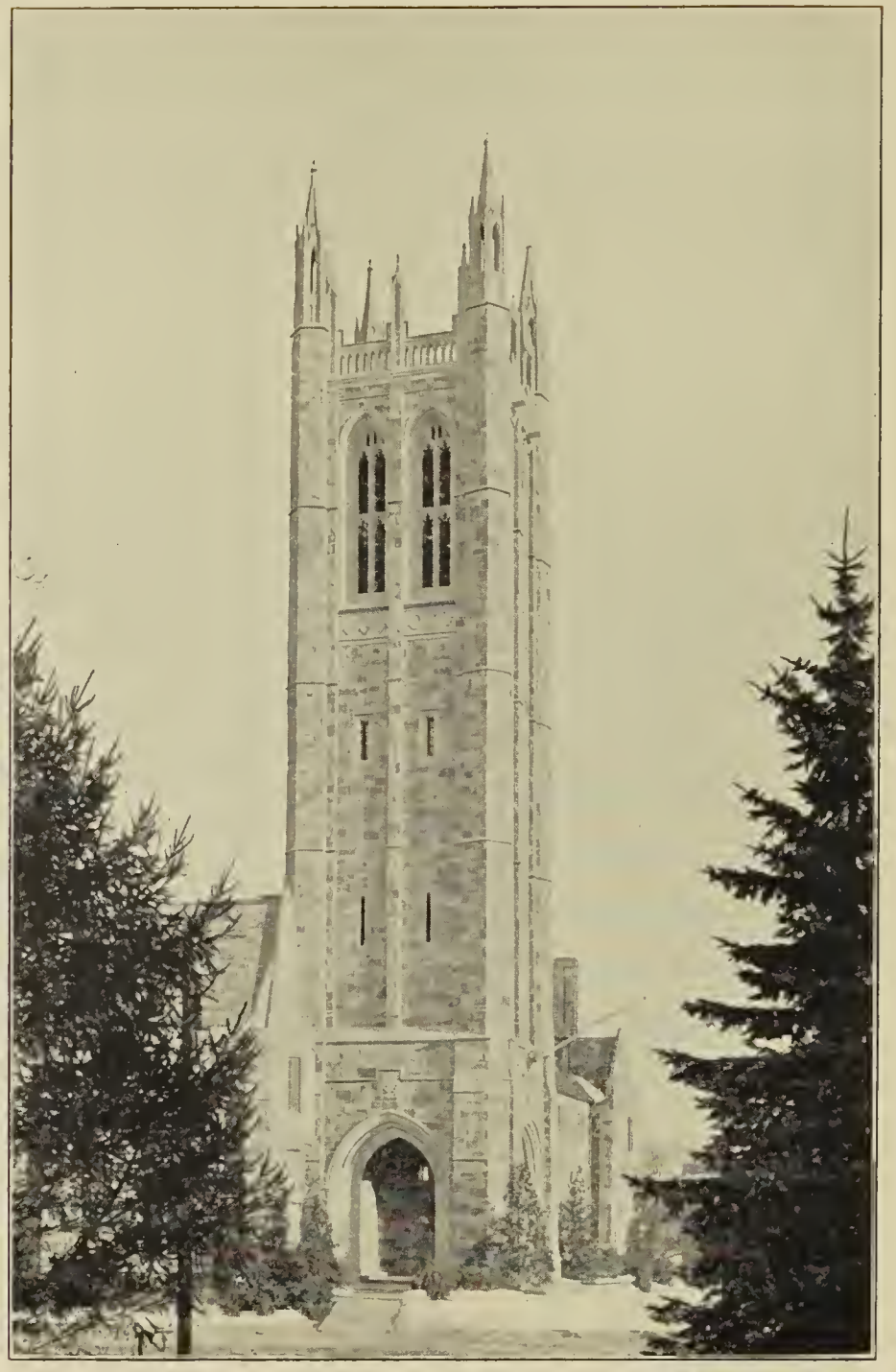
THE Flêche of this building contains a small but very musical Carillon of 23 bells, the Bourdon, note G♯, weighing 1,456 lbs. (13 cwts.), the total weight of bells being 3 tons, 5½ cwts. (7.280 lbs.).

Operation is by clavier for special recitals by a skilled carillonneur and daily by automatic tune playing mechanism.

The paper band machine, controlling the tunes, is placed in the basement of the building and as the bands are easily changed a varied programme of music is possible.

Some of the special bands in use are perforated to play the quarter chimes on ten bells, strike the hour, and end with an air such as Mendelssohn's "Spring Song."

¶ *The entire installation—bells, steel framework and operating mechanism—was manufactured at Croydon by Gillett & Johnston.*



Architect : William G. Upham

Norwood War Memorial Tower, Mass., U.S.A.

No. of Bells	50
Weight of Bourdon (Note A♮)	3¼ tons (7280 lbs.)
Total Weight of Bells	18½ tons (41,440 lbs.)

Inscription on Bourdon.

This Carillon is Dedicated to Good Citizenship and commemorates the Service and Sacrifice of the Citizens of Norwood in the cause of Justice, Liberty and Truth 1775—1917

Presented to the Town of Norwood by Walter F. Tilton, 1927

Glory to God in the Highest, and on Earth Peace,
Good Will Toward Men.

North East Coast Exhibition, 1929
Newcastle-on-Tyne

The Wellington War Memorial Carillon, loaned by the Dominion Government of New Zealand for six months prior to shipment, was inaugurated on May 14th, by H.R.H. the Prince of Wales, in the presence of Sir James Parr, K.C.M.G., High Commissioner for New Zealand; the Lord Mayor of Newcastle (Councillor A. W. Lambert) and the Lady Mayoress; the Duke and Duchess of Northumberland and Lord and Lady Londonderry.

Extract from the "Newcastle Evening Chronicle," May 20th, 1929

"In its long history the wide open space which is the Newcastle Town Moor has witnessed some astonishing scenes, but it is questionable whether it has ever realised so impressive a demonstration of general public interest and enthusiasm in one subject as was indicated yesterday in the wonderful Carillon.

"All day long in the brilliant sunshine the great open space was a panorama of moving crowds; crowds that streamed in from all entrances to the great playground to cover almost every available inch of ground

Part of the audience of 100,000 people on the Town Moor, Newcastle-on-Tyne, who listened to the Wellington War Memorial Carillon on Sunday, May 19th. On the following Sunday the audience was estimated at 200,000.

"near the North side of the Exhibition and to form one of the biggest multitudes that have ever gathered on the spot.

"Truly it was an amazing spectacle. Crowds of people, moving along every road and from every direction, converged upon the spacious Moor. They walked, or they came by bicycle, by 'bus and by tram, or in their own motor-cars to hear one of the world's most entrancing peals of bells played by an acknowledged master.

"Mr. Ball, the Carillonneur, gave three recitals yesterday—morning, afternoon and evening,

"The Carillon has thrilled not only the city and the immediate district, but has gone quivering throughout all parts of the North-country.

"The amazing crowd of yesterday was not totally constituted by the tens of thousands who strolled from the city and suburbs; included in it there were thousands of people who, fired with the wonderful stories of the fascination of the bells, had travelled from some of the remotest parts of the North.

"The silvery notes of the bells were heard in ideal conditions, and as they floated out across the wide expanse of the Town Moor they struck a chord in the hearts of every one of the huge crowd.

"The sight of the tremendous open-air congregation, so deeply attentive and at times profoundly stirred, was one that will live in the memory of all who were present."

The complete Carillon contains 49 bells, the heaviest weighing 5 tons (11,200 lbs.) and it is operated by a clavier and also by the firm's patented electro-pneumatic mechanism including ivory keyboard for remote control and paper band Automatic Player, the latter started as required from a master timepiece.

Architects : Warren & Wetmore, New York, U.S.A.

The University Library of Louvain

No. of Bells in Carillon	...	...	...	48
Weight of Bourdon (Note F♯)	...	...	...	7 tons (15,680 lbs.)
Diameter of Bourdon	...	...	...	89″
Total Weight of Bells	..	...	...	31 tons 5 cwts. (70,000 lbs.)

The Dedication of the Library, Carillon and Clock took place on July 4th, 1928, in the presence of H.R.H. Prince Leopold of Belgium, by His Eminence Cardinal van Roey, Archbishop of Malines, assisted by Belgian and American Bishops and Dignitaries.

The building fronts a fine square that forms an ideal auditorium for Carillon concerts. A million contributions from American citizens provided the cost of the building. Height of tower, 285 feet. Height of Carillon from ground, 230 feet.

The University Library of Louvain *(continued)*

Dr. EDWARD DEAN ADAMS
(Chairman of Engineering Foundation)

THE proposal to present the Carillon to Louvain University originated last summer with Dr. Edward Dean Adams, Honorary Member of the Engineering Foundation, and formerly President of the Cataract Construction Company which planned and built the works for the Niagara Falls Power Company.

Dr. Adams attended the celebration of the 500th Anniversary of the University as the delegate of the Engineering Foundation and other societies. While in Louvain he visited the beautiful new Library buildings, of which Mr. Whitney Warren, of New York, is architect, and Mr. Carroll Greenough, of Paris, associate architect, to replace the ancient one which was burnt down at the beginning of the war. It occurred to Dr. Adams that the fine tower would not seem complete to the Belgians unless it possessed the two features they associate with their belfrys—a Clock and a Carillon. It also occurred to him that no memorial had yet been put up for the hundreds of Engineers of the United States who had given their lives in the service of their country and its Associated Powers.

Combining these ideas, Dr. Adams suggested that members and friends of American Engineering Societies should present the University of Louvain with a Clock and a Carillon in memory of their members who fell in the War, and also as a token of international goodwill.

Dr. Adams' suggestion has been realised in the Clock and Carillon now installed, the cost of which has been subscribed by sixteen different Engineering Societies.

In designing the Louvain Carillon the Committee on War Memorial to American Engineers has had the advice of Mr. Frederick C. Mayer, organist and choirmaster of West Point Military Academy, New York, who completed his inspection of the bells at Croydon in May, 1928.

Mr. Mayer, has heard most of the leading Carillons of Europe and practically all those in America and Canada. He is satisfied that the Louvain Carillon is the best tuned, and has the finest musical properties of any that he has heard.

St. Jan's Cathedral s'Hertogenbosch, Holland.

In the tower now hangs a Carillon of 43 bells, the Bourdon bell (note D), 56″ diameter, weighing 33 cwts. (3,696 lbs.). There are 39 new bells, three of Belgian make (19th century) and one Hemony bell, dated 1664, with which the whole Carillon was tuned.

Second International Carillon Congress and Opening of the New Carillon at s'Hertogenbosch, August 14th, 1925
In the above group, with the Burgomaster, are many of the leading Carillonneurs of Belgium and Holland.

St. Joseph's Church, Tilburg, Holland

ST. JOSEPH'S CHURCH, TILBURG, HOLLAND

At Tilburg. a new Carillon of 35 bells, the Bourdon bell (Note E), 49" diameter, weighing 22 cwts. (2,464 lbs.), was installed in 1925.

BARNEVELD

At Barneveld, a new Carillon of 24 bells, the Bourdon bell (Note D), 29" diameter, weighing 5 cwts. (560 lbs.), was installed in 1927.

Barneveld

Turnhout

TURNHOUT

At Turnhout there is a Carillon of 41 bells, by Van den Gheyn (18th century). One of the smaller bells was cracked and had been re-cast a number of times unsuccessfully. The firm heard of this and re-cast the bell as a gift to the town of Turnhout in 1924. The re-cast bell now blends perfectly with the remainder of the Carillon, which is one of the few instances of an old Carillon, in which all the bells were cast by the same founder.

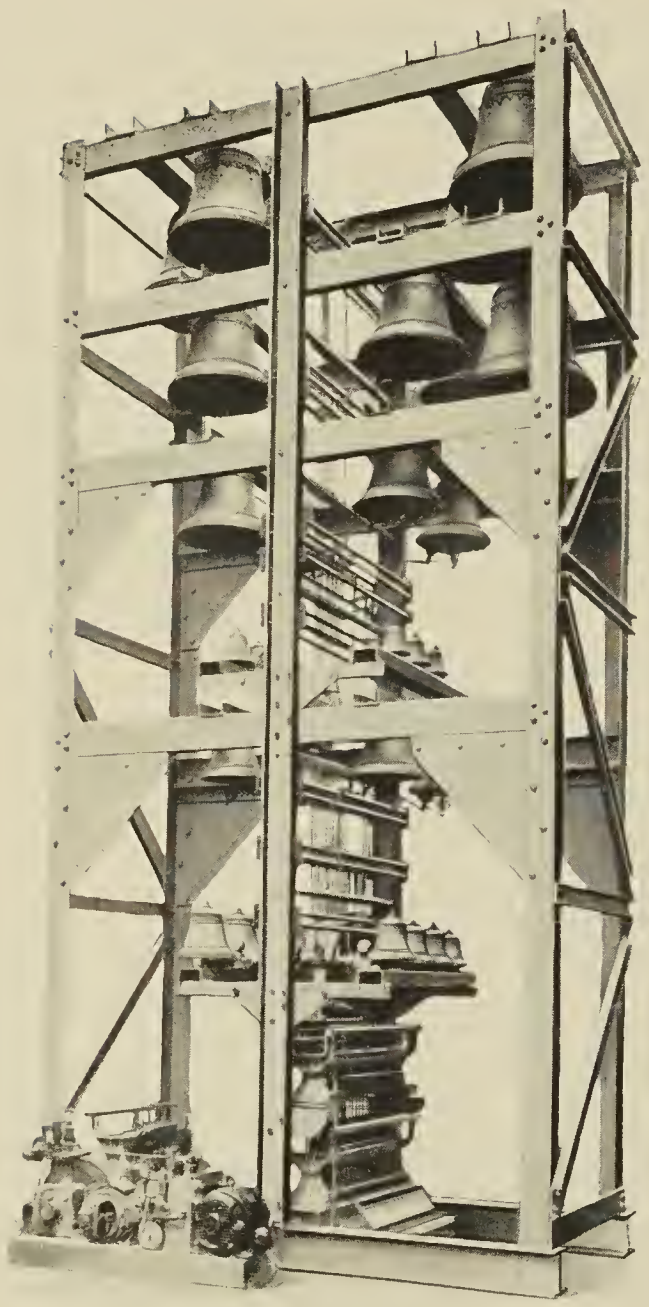
Regal Cinema, Marble Arch, London (Eng.)

Architect : Clifford A. Aish, F.S.I., L.R.I.B.A.

THE Carillon consists of 32 bells—the Bass Bell weighing 6 cwts., its note corresponding to middle "C", and rising chromatically through 2½ octaves to high "G." The total weight is approximately 2½ tons.

The Regal Bells are hung in a steel frame in a specially constructed chamber to one side of the stage. A complete self-contained power plant is provided. At the base of the bell frame is a set of

Regal Cinema, Marble Arch—(*continued*)



Regal Bells

electro-pneumatic pistons—one to each bell—connected directly through a tracker work of cranks and rollers to the bell clappers. A remote control gear is fitted for starting up the power plant, and, by pressing a button and pulling out the "Carillon" stop on the console, the organist brings the bells into play. This entire system has been evolved and patented by the bell founders.

In order to control the volume of sound from the Carillon, the bell chamber is provided with a specially designed set of "shutters" which may be opened or closed to the desired extent by the organist, who is thus able to produce "distance" and "swell" effects at will.

This is the first time that proper bells—as apart from tubular bells—have been attached to an organ in any way and used in a Cinema.

The Carillon is one of the smallest in the world for weight relative to the number of bells.

¶ *The entire installation, including the bells, steel framework, operating mechanism, and the clock mechanism, was manufactured at Croydon by Gillett & Johnston.*

Chimes

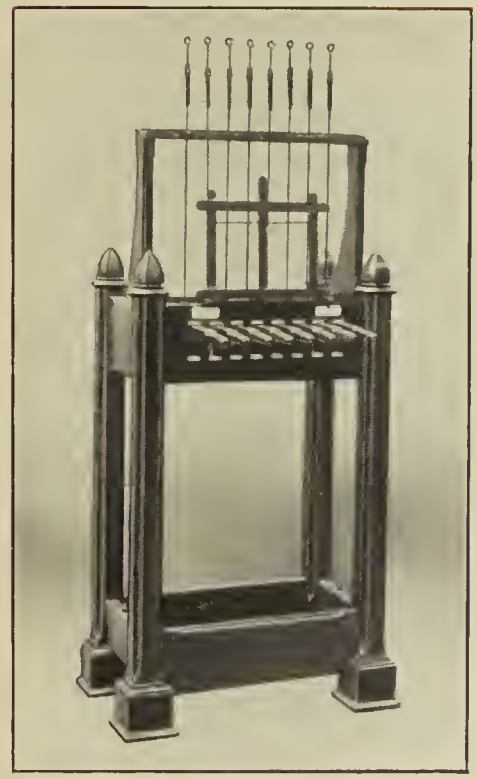


Fig. 1. Clavier

A "CHIME" consists of any number of bells less than 23, other than a Ringing Peal. If there are 23 or more it is usual to speak of the bells as a Carillon.

With eight bells, tuned as a single octave without any semi-tones, a considerable number of simple tunes can be played as well as "changes."

The addition of two extra treble bells, making ten diatonic notes, increases the number of tunes available, while a chime of 14 bells (12 diatonic and two semitones) allows for a considerably extended repertoire covering many of the best known hymns.

Operation is by one or more of the following methods:—

Clavier: Fig 1. This is either self-contained for placing on the floor, or arranged without a stand for fastening to the wall. The wooden hand levers are connected by wires, cranks and rollers to clappers striking on the inside of the bell.

Drum: Fig. 2. The large barrel is pegged as in a musical box, to play three or four simple tunes. The pegs depress levers, which lift and release hammers striking on the outside of the bells. It is driven either by weights or an electric motor.

Electro-Pneumatic Mechanism: Fig. 3. The action is identical with that in use on our Carillons; inside clappers are used and the control is by ivory keyboard for hand playing or by a Paper Band Automatic Playing Machine.

Automatic Change Ringing Machine: Fig 4. "Changes," that is a sequence of notes used when the bells are swung by a trained band of Bell-ringers, can be played effectively by means of a motor-driven machine of the drum type, operating hammers striking on the outside of the bells. This machine is usually started and stopped from a convenient position on the ground floor.

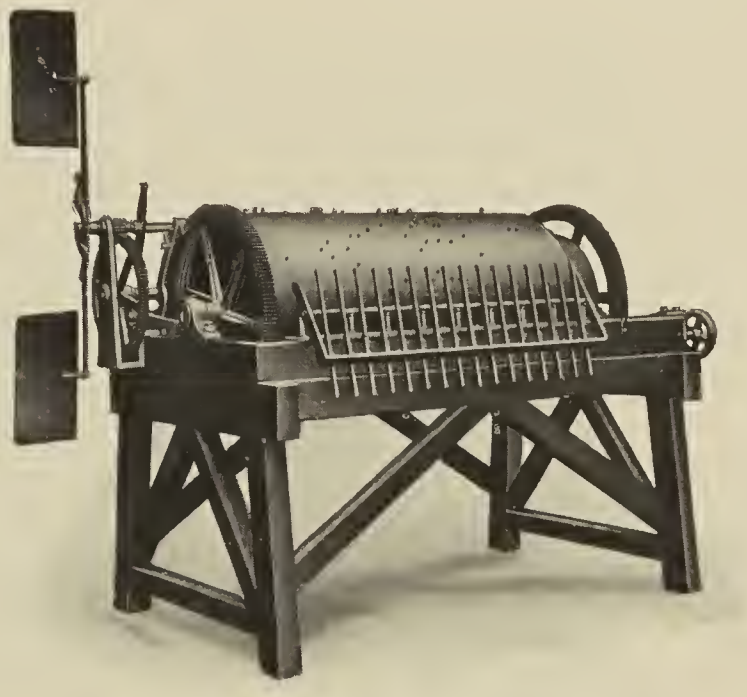


Fig. 2. Weight Driven Tune Playing Machine

Chimes—*(continued)*

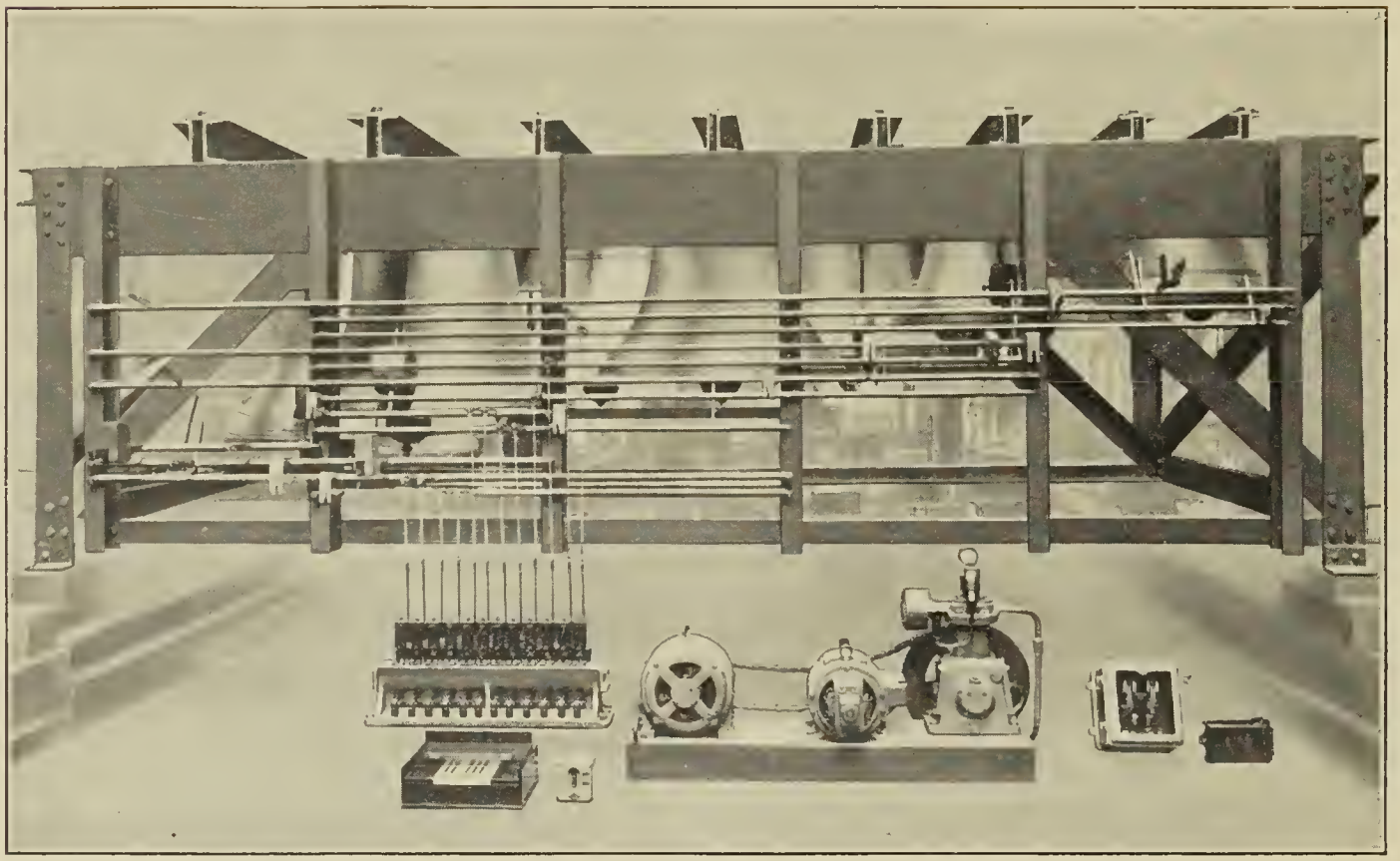


Fig. 3. Chime of Eight Bells with Electro-pneumatic Operating Gear

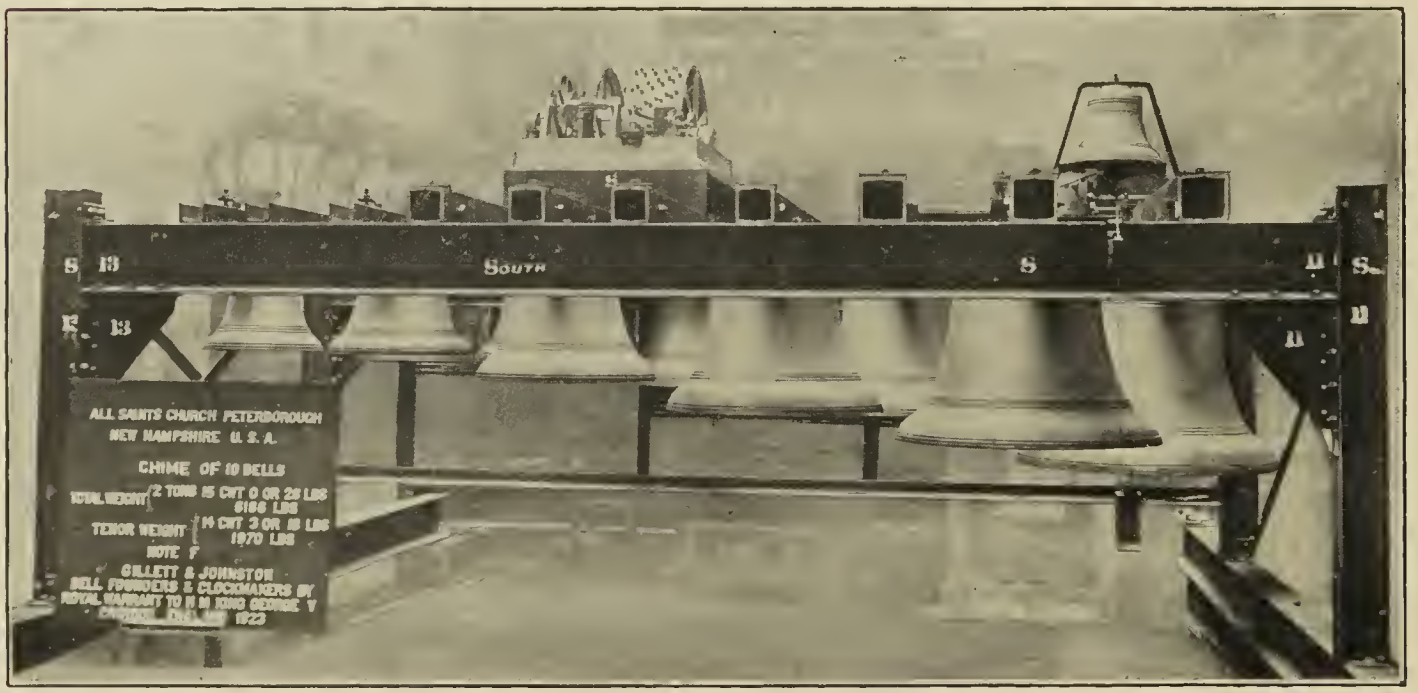
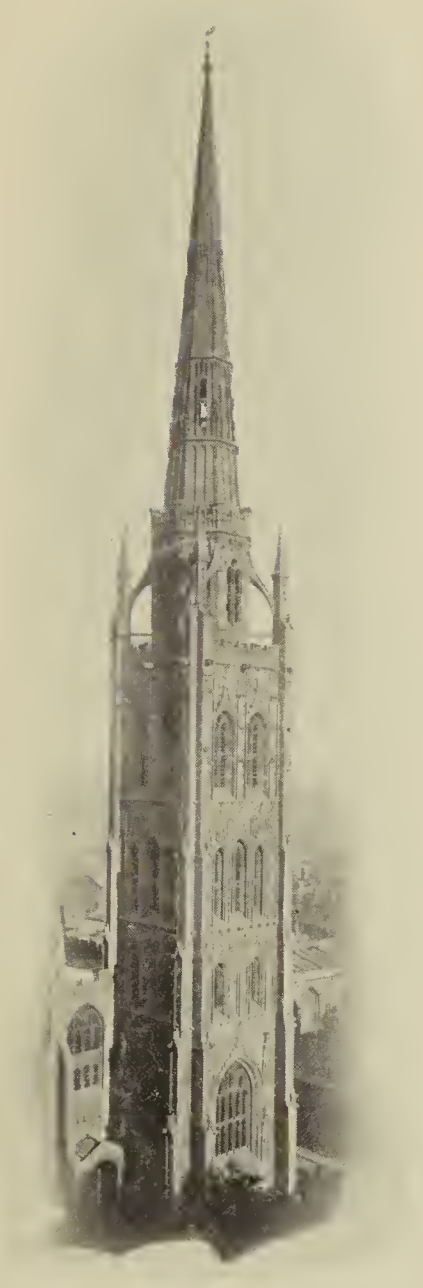


Fig. 4. Chime of Ten Bells with Machine for Playing "Changes"

Chimes

Some Examples of Our Latest Installations



Coventry Cathedral

Fourteen Bells with Hand and Automatic Playing Mechanism

ENGLAND

County and Place	No. of Bells	Note	Weight of Largest Cwts. qrs. lbs.	Date
Cornwall				
Breage	8	C	6 0 10	1928
Gunwalloe	6	Eb	4 2 14	1926
Devonshire				
Kennerleigh	8	F♯	2 0 19	1920
Lower Brixham, All Saints' ...	8	D	4 3 21	1928
Dorset				
Stanbridge	6	D	4 1 12	1928
Talbot Village	12	F	3 2 2	1929
Durham				
Beamish, St. Andrew's ...	11	F	16 0 0	1929
Horden, St. Mary's ...	8	C	5 0 11	1929
Essex				
Gt. Warley	8	D	5 0 17	1923
Kent				
Tunbridge Wells, St. Luke's...	8	F♯	14 0 25	1919
Lancashire				
Barton-on-Irwell	8	Ab	9 3 16	1921
Clitheroe, St. James' ...	10	B	7 0 19	1923
Edenfield	8	Bb	6 2 9	1921
Little Lever	8	Bb	6 3 3	1920
London				
Canonbury, St. Paul's ...	8	Bb	6 1 23	1920-26
Royal Exchange, London ...	13	C♯	33 0 7	1920
West Ham Central Mission	10	A	9 1 26	1925
Winchmore Hill, Holy Trinity	8	B	5 0 22	1919
Middlesex				
Brentford, St. George's ...	6	A	7 1 8	1913
Clay Hill, Enfield, St. John's	8	F♯	3 0 6½	1927
Northants				
Duddington	6	Bb	6 2 19	1920
Shropshire				
Easthope	6	D	5 0 0	1921-29
Surrey				
Addlestone	8	E	3 1 18	1924
Holmbury S. Mary ...	6	E	4 1 9	1927

Chime of 18 Bells in a Tower on a Country Estate.

SCOTLAND

County and Place	No. of Bells	Note	Weight of Largest cwts.	qrs.	lbs.	Date
Bellahouston	8	A	9	0	21	1924
Broughty Ferry	9	G♯	8	0	17	1920
Dumfries	8	E	3	1	23	1924
Greenock Par. Ch.	9	E	14	0	0	1911
Newburgh-on-Tay	8	A	8	1	10	1921
Sanquhar	10	A♯	8	3	17	1928

CANADA

Halifax, N.S. (St. John's)	13	F	16	1	0	1920
Halifax, N.S. St. Mary's Cathedral	11	F♯	14	0	15	1920
Toronto(St.John's)	10	Eb	23	3	2	1924
Toronto (St. John's) Kingston Road	8	A	9	0	10	1926

INDIA

Dehra Dun (St. Thomas')	6	F♯	3	0	5	1927

NEW ZEALAND

Fendalton(St.Barnabas)	8	D♯	4	1	21	1926

U.S.A.

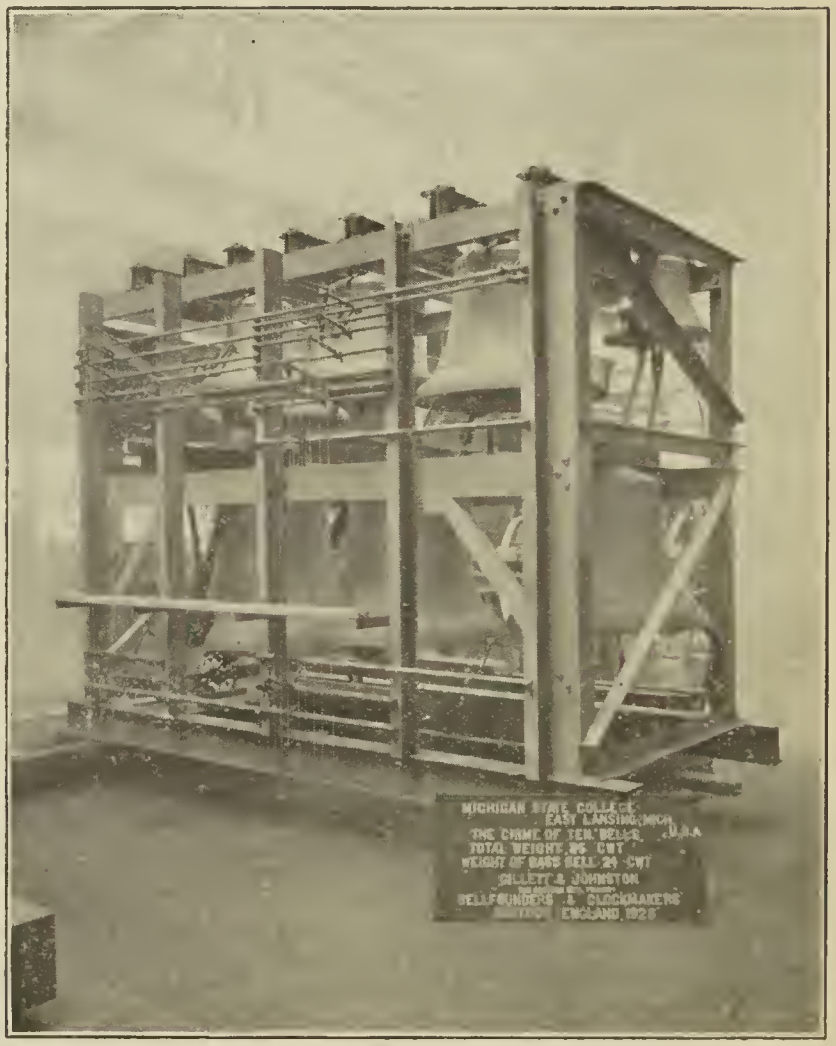
Cleveland, Ohio	8	D	5	0	0	1927
East Lansing (Michigan State Coll.)	10	E	24	3	16	1929
East Orange, N.J.	14	E	24	2	22	1926
Fond du Lac, Wis.	8	A	9	3	24	1927
Grosse Pointe, Detroit, Mich.	8	C♯	43	1	14	1926
Peterborough, N.H.	10	F♯	14	3	17	1923

ENGLAND—*(continued)*

County and Place	No. of Bells	Note	Weight of Largest cwts.	qrs.	lbs.	Date
Sussex						
Copthorne ...	6	B	6	3	14	1919
Paddockhurst ...	8	Eb	24	2	23	1921
Warwickshire						
Coventry Cathedral	14	Db	33	3	8	1927
Smethwick ...	8	E	3	1	18	1924
Yorkshire						
Selby	10	B	6	3	9	1927
Stannington ...	8	E	3	1	14	1924
Wentbridge ...	6	B	5	2	26	1913

IRELAND

Strabane ...	8	C	5	1	21	1920



Framework for a Chime of 8 bells for Michigan State College, East Lansing, Mich., U.S.A.

Single Bells

THE illustrations shew four of the more usual methods of operation, covering almost all requirements for Churches, Schools, and Fire Alarms. The bells which swing (Figs. 1, 2 and 4) give a greater volume of sound than those hung "dead" (Fig. 3).

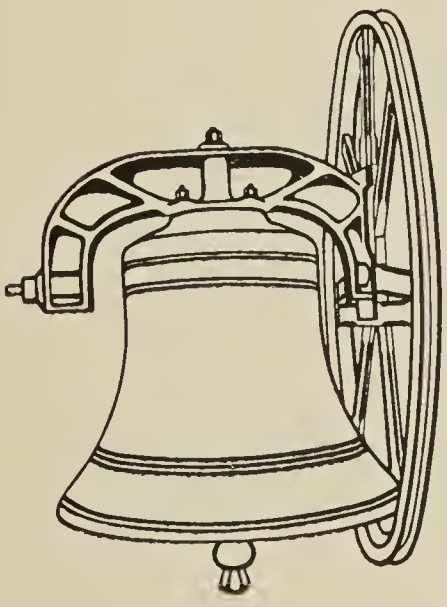


Fig. 1

In Fig. 1 the method of ringing the bell is by means of a rope attached to the wheel and passing over pulleys to the ringing room or to the floor of the building. The headstock is of curved design in order to "tuck" the bell properly and to reduce the leverage required for ringing, and the wheel is built up of Oak, Ash, and Elm, to give the maximum strength and lightness, and is bolted to the headstock and stayed with wrot iron plates, the garter hole being specially designed to prevent chafing of the rope. Ball bearings of an unusually substantial type are fitted, with self-aligning double races: they are dust-proof and grease-tight, and fitted with Stauffer grease caps for lubrication, which is only required at long intervals. The bell is shipped complete with wrot iron clapper of correct dimensions, and suspension bolts, with the necessary insulating material to prevent metallic contact between the bell metal and the bolts or headstock; rope of the best Italian hemp with soft woollen sally, and pulleys. For export all bells arranged as in Fig. 1 are pivoted near the centre to slow down the speed, reduce lateral thrust, and economise space.

Fig. 2 shews a smaller bell mounted on a forged steel headstock and fitted with plain gunmetal bearings, lever, clapper, suspension bolts, rope and pulleys. The fall of the rope may not always be perpendicular, and by the addition of one or more pulleys it can be led down to any required position.

Fig. 2

Fig. 3 illustrates our improved method of striking a bell hung "dead," the action being designed so as to make it impossible to fracture the bell by continuing to pull on the rope after the clapper has made contact. This arrangement is used when the turret is either too small or not strong enough to support a swinging bell, or if distinct sequences of blows are required, as when the Angelus is sounded. Clapper, suspension bolts, rope and pulleys are supplied, but no beam is included unless specially ordered.

Fig. 4. When no turret is available a bell weighing up to about 2 cwts. (224 lbs.) and measuring 21″ diameter can be swung in the forged steel framework shewn, which is secured to the side of a building. If required, the bell can be operated from inside by carrying the headstock through the wall.

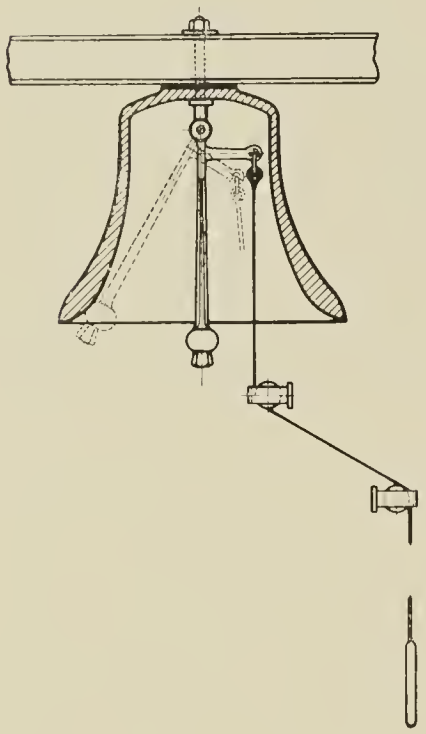


Fig. 3

The forged steel headstock is pivoted in gunmetal bushes and the bell is supplied complete and ready for fixing in place with the frame, lever, rope, pulleys and wall bolts of normal length. The thickness of the wall should be given when ordering.

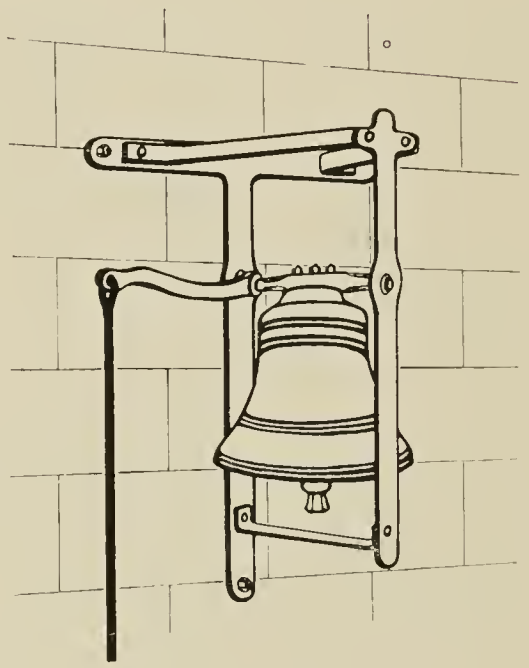


Fig. 4

List of Prices

	Note	Dia.	Weight Cwt.	qrs.	lbs.	Lbs.	Price F.O.R. Croydon	Price F.O.B. London Docks	Weight and Cubic Measurement for Calculating Freight Cwt.	qrs.	lbs.	Lbs.	Cu. ft.
Fig. 1	D	29″	5	0	0	560	£101	£106	8	3	0	980	42
,,	B	33½″	7	1	0	812	£124	£129	11	3	0	1316	51
,,	G	42″	14	2	0	1624	£211	£217	19	3	0	2212	83
Fig. 2	C♯	16½″	1	0	7	119	£23	£25	1	3	0	196	5
,,	G♯	21″	2	0	0	224	£36	£38	3	0	0	336	8
,,	F♯	24″	3	0	7	343	£48	£51	4	0	0	448	11
Fig. 3	C♯	16½″	1	0	7	119	£22	£24	1	2	0	168	5
,,	G♯	21″	2	0	0	224	£34	£36	2	2	0	280	7
,,	F♯	24″	3	0	7	343	£46	£49	3	3	0	420	10
Fig. 4	F♯	13″	0	2	7	63	£20	£22	2	0	0	224	5¾
,,	C♯	16½″	1	0	7	119	£28	£31	3	2	0	392	9½
,,	G♯	21″	2	0	0	224	£43	£46	5	2	0	616	18½

Some Specimen Bell Inscriptions

1. They shall give thanks unto Thy Name : which is Great, Wonderful, and Holy.

2. O ye spirits and souls of the righteous, bless ye the Lord : praise Him and magnify Him for ever.

3. Sunday observe. Think when the bells do chime.
   Tis Angels' music : therefore come not late.

4. Such wondrous power to music's given,
   It elevates the soul to heaven.

5. May the Spirit of the Lord reach the heart of every one where the sound of these bells is heard.

6. Lord, may these bells for ever be
   A tuneful voice o'er land and sea
   To call Thy people unto Thee.

7. Are they not all ministering spirits, sent forth to minister for them who shall be heirs of salvation.

8. Blessed be His glorious Name for ever : and let the whole earth be filled with His glory, Amen and Amen.

9. Sing to the Lord, for He hath triumphed gloriously.

10. O praise God in His holiness : praise Him in the firmament of His power.

11. All Thy works praise Thee, O Lord : and Thy saints give thanks unto Thee.

12. O give thanks unto the God of heaven : for His mercy endureth for ever.

13. Shew yourselves joyful unto the Lord : sing, rejoice and give thanks.

14. So teach us to number our days : that we may apply our hearts unto wisdom.

15. Sing we merrily unto God our strength.

16. Lift up your heads, O ye gates, and be ye lift up, ye everlasting doors : and the King of Glory shall come in.

17. Serve the Lord in fear : and rejoice unto Him with reverence.

18. Ring out the old, ring in the new ;
    Ring out the false, ring in the true.

19. God's in His heaven : all's right with the world.

20. Placed here on high we serve the town
    Beneath the crown, beneath the sky.

21. Differing in size and note and weight,
    Yet small or great we harmonise.

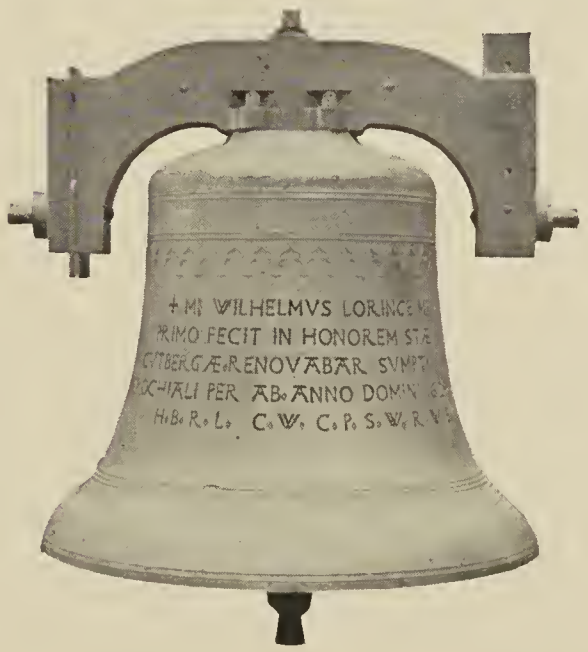
22. To everything there is a season : and a time to every purpose under heaven.

23. Every day sincerely pray.

24. Music is medicine for the mind.

25. Glory to God in the highest, and on earth peace to men and good will.

26. Venite Adoremus.



27. I mean to make it understood, that though I'm little yet I'm good.

28. The law temporal : the Gospel eternal.

29. At proper times our voices we will raise
In sounding to our benefactor's praise.

30. Whilst thus we join in cheerful sound,
May love and loyalty abound.

31. O sing praises, sing praises unto our God.

32. Keep thy tongue from evil : and thy lips that they speak no guile.

33. God be merciful unto us and bless us.

34. Whoso dwelleth under the defence of the most High : shall abide under the shadow of the Almighty.

35. The Lord preserveth the souls of His saints.

36. May God bless all
Whom we do call.

37. For the honour of God,
And the use of this church,
These bells were raised.

38. Keep peace and good neighbourhood.

39. I toll the funeral knell,
I ring the festal day,
I mark the fleeting hours,
And chime the church to pray.

40. To all Christ's flock I loud do sing.

41. Let everything that hath breath : praise the Lord.

42. Time how short : Eternity how long.

43. Hark how I call. Prepare your heart and come
To the House of God, and Kingdom of His Son.

44. Our voices shall with joyful sound,
Make hills and valleys echo around.

45. Prepare ye the way of the Lord.

46. Draw near to God and He will draw near to you.

47. He and he only aims aright,
Who joins industry with delight.

48. Death is swallowed up in victory.

49. Here let us pause and each with one accord
Salute the church triumphant in the Lord.

50. May peace and plenty smile on our fair shore
And war's dire tumult cease for evermore.

51. O Lamb of God, that takest away the sins of the world, have mercy upon us.

52. In sweetest sounds let each its note reveal ;
Mine shall be first to lead the dulcet peal.

53. I sweetly tolling men do call
To taste of meats which feed the soul.

54. Our sounding is each man to call
To serve the Lord, both great and small.

55. The hills and vales and towns all round
Shall echo with a pleasant sound.

56. To church, the House of God, come all, I cry
To praise His Name to all eternity.

57. Let thine eyes be open and let thine ears be attentive unto the prayer that is made in this place.

58. This is none other but the House of God and this is the gate of Heaven.

59. Sancta Maria, ora pro nobis.

60. Ave Pater Rex Creator,
Ave Fili Lux Salvator,
Ave Sancti Trinitas.

Memorial Tower, Buenos Ayres

Tower Clocks

SINCE 1844 more than 13,000 Tower Clocks, with or without bells, have been made at the Croydon Factory, in addition to many thousands of smaller clocks.

They are supplied to the Admiralty, War Office, Crown Agents for the Colonies, India Office, etc., and are at work in Government Buildings, Railway Termini, Memorial Towers, City Halls, Dock Yards, Harbours, Cathedrals and Churches in practically every part of the world.

They are operated by weights or by electric motors and are made in a complete range of standard types and sizes, including non-striking, hour-striking, full quarter chiming, ships bells, Angelus, etc. They drive the hands of dials measuring from two feet diameter to fifty feet diameter or more, and strike on bells weighing up to twenty tons.

The materials used are of the highest quality; with our own foundries this can be absolutely guaranteed. All clocks are thoroughly tested under actual working conditions for some time before being put into stock or packed for delivery: they are guaranteed to leave the Works in perfect going order.

We are the only firm in the world who manufacture both Tower Clocks and Bells and are thus in the unique position of being able to accept undivided responsibility for a contract for the complete equipment of a Tower.

Toronto City Hall
Dials, 20 feet diameter ; Hour Bell, 6¼ tons

Tower Clocks

Among the most important of these are the following :

St. James's Palace, London
Windsor Castle
Royal Courts of Justice, London
Ottawa Parliament Buildings (destroyed by fire)
Ottawa Parliament Buildings, New Victory Tower
Toronto City Hall
Montreal Harbour Memorial Tower
Manchester Town Hall
Bradford Town Hall
Lancaster Town Hall
Chorley Town Hall
Lambeth Town Hall
Cardiff Town Hall
Birmingham Art Gallery
Madras Town Hall
Rangoon Municipal Buildings
Calcutta Market Tower
Lagos Town Hall
Launceston (Tas.) Post Office
Bombay Harbour
Royal Courts of Justice, Pekin
Royal Exchange, London
Buenos Ayres Memorial Tower
Owen Sound (Ont.) Town Hall
St. Paul's Cathedral, London (Ont.)
Amherst (N.S.) Post Office
Montreal, St. George's Church
Reading University
Zanzibar
Simcoe (Ont.), Norfolk Soldiers' Memorial
Quelph (Ont.), St. George's Church
Zomba, Nyasaland
Kuala Lumpur Town Hall, (F.M.S.)
Mar del Plata Railway Station
Pietermaritzburg Town Hall
Johannesburg Post Office
Sydney Post Office
Pernambuco, Tacaruna Cotton Mills
Antofagasta, Argentina
Bath Abbey
Singapore Memorial Tower
Funchal Cathedral
Sourabaya (Java)
Port Elizabeth (S.A.) Post Office
Penang Memorial Tower
Seychelles Memorial Tower
Gibraltar Barracks
Penang Railway Station
Maradana Railway Station (Ceylon)
Eaton Hall, Westminster
British Honduras (Crown Agents)

Tower Clocks

(Weight Driven)

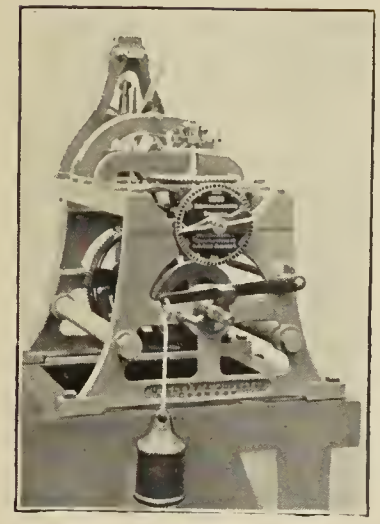


Fig. 1. No. 1 Timepiece

AN experience extending over 90 years, has enabled us to bring each detail of the mechanism of our Tower Clocks to a remarkable degree of perfection.

It is essential that, in view of the large number of clocks shipped to every part of the world, the utmost simplicity and freedom from wear and tear and break-down should be attained. We ensure this by the use of the most suitable material, by designs perfected by experience, and last, but not least, by the best workmanship possible.

The most accurate time-keeping is obtained by the use of Lord Grimthorpe's "Double Three-Legged Gravity" escapement, in conjunction with a pendulum compensated to counteract the effect of changes of temperature. With this escapement the pendulum receives a constant impulse, unaffected by wind pressure, snow, etc., on the hands, and in practice it is found to keep time to within three seconds a week.

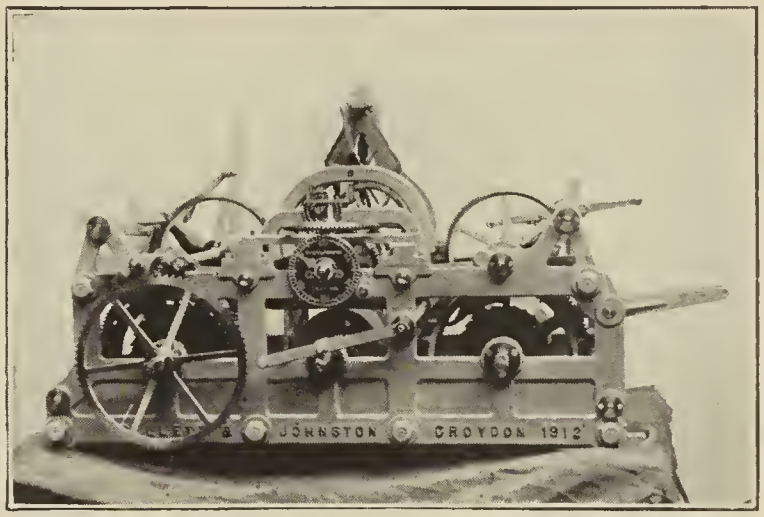


Fig. 2. No. 2 Westminster Quarter

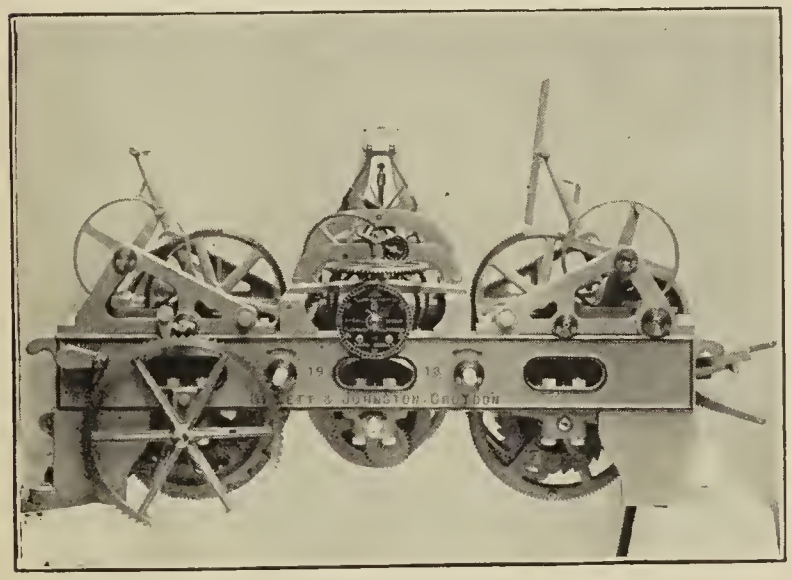


Fig. 3. No. 3 Westminster Quarter

The "Dead Beat" escapement that we have adopted as standard for the past twenty years is of the pin wheel type which keeps as accurate time as the "Graham" escapement, but which is much more durable and better suited to tower clock work. The "scape" wheel is of gunmetal of light section and the pins of hard phosphor

Tower Clocks, Weight Driven—(*continued*)

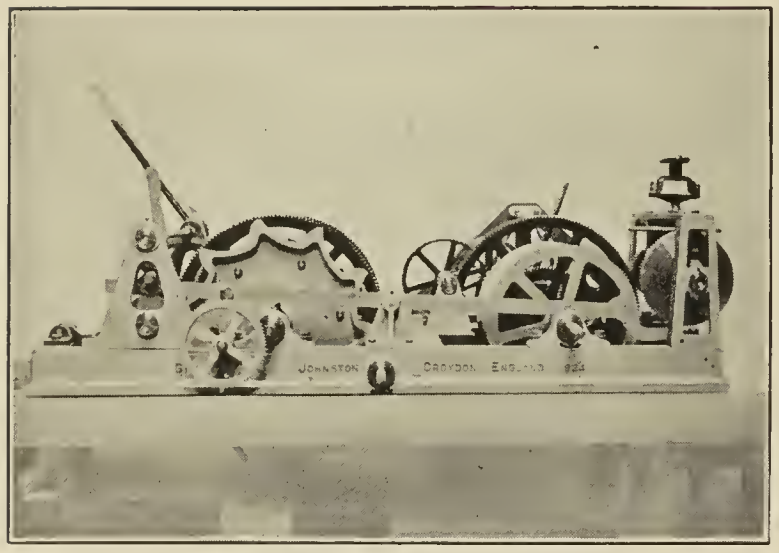


Fig. 4. No. 6 Striking

bronze secured with dove-tail riveting; a simple and efficient safety attachment on the "crutch" effectually protects the escapement from any possibility of injury.

The pendulum spring fittings are of gunmetal so as to avoid the rusting effect of steel against the spring.

Clocks with "Gravity" escapements have compensated pendulums of "Invar" or similar steel; those with "Dead Beat" escapements have wood rods of straight-grained pine, or of teak for India.

The pendulums of the smaller clocks beat one second, those of medium sized clocks, one-and-a quarter seconds and those of the largest clocks two seconds in each direction.

For convenience in handling, the weights are supplied in slotted sections weighing about 56 lbs. each and these are hung in the corner of the tower on steel cables of high tensile strength.

All Tower Clocks are of standardised design; the component parts are manufactured on modern precision machines and are assembled and tested by skilled tower clock makers of long experience. Each clock is thoroughly tested under working conditions before despatch.

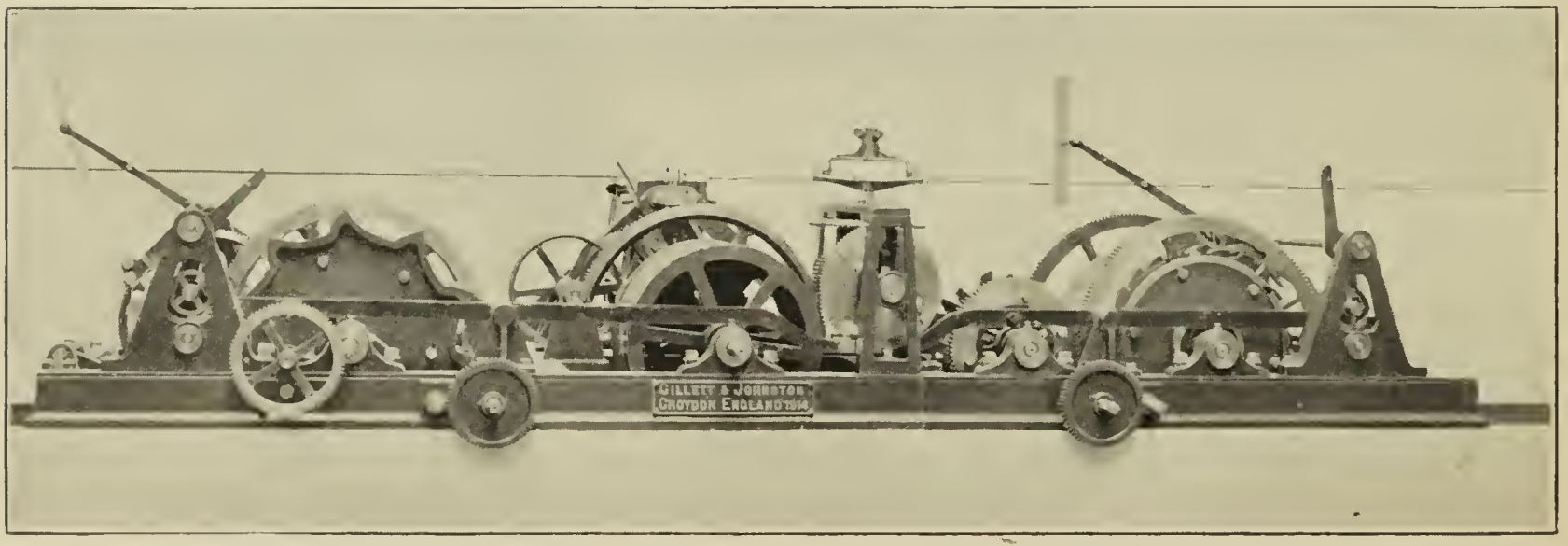


Fig. 5. No. 6 Westminster Quarter

Electrically Operated Tower Clocks

WHILE the weight-driven tower clock remains the most simple of all, it is frequently difficult, if not impossible, to find a position for the long weight shaft; the cost of labour, also to wind weights of over half a ton to the top of the tower every two or three days is great.

A standard line of electrically operated tower clocks has therefore been evolved during the past fifteen years, and examples of these are at work in all parts of the world.

In most cases small electric motors from ¼ h.p. upwards are used, automatically winding a small weight for the "Going Train" and operating the striking and quarter hammers through worm reducing gearing.

In the case of the "Going Train" in the smaller sizes, the weight of 20 lbs. is raised through a space of 9 inches every hour, and should the current fail the clock does not stop for 3 to 4 hours, rewinding itself as soon as the current is again available if within this time. A longer margin can always be given allowing the 20 lb. weight to pass through the floor. On the largest clocks a run of 24 hours after the current has failed is allowed for.

The standard pendulum, escapement and upper train of the old and well tried weight-driven clock is retained providing in a very safe and simple way the advantages of both types of clock.

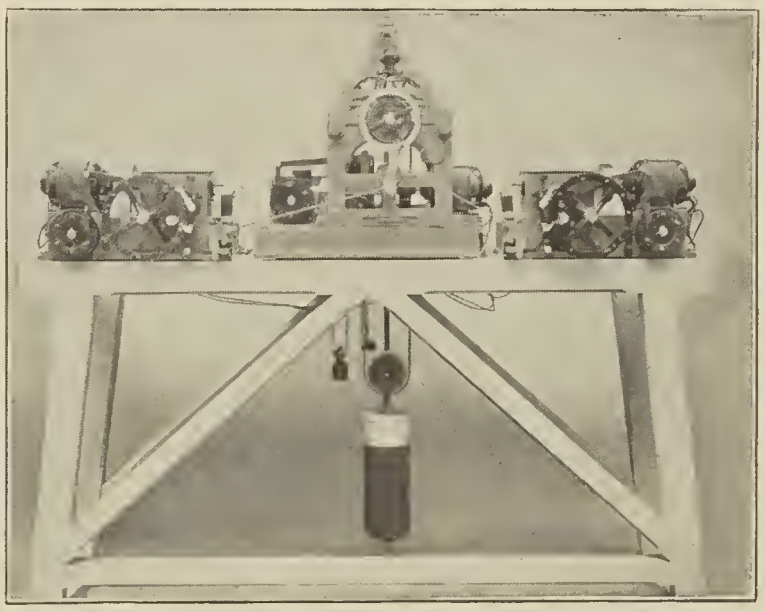
The striking and quarter mechanisms are always separate units in our electrical tower clocks, so that they can each be placed to the best advantage in the tower, often reducing the number of connecting cranks and rollers and making a more simple and efficient layout possible. The motors only function during the actual striking and chiming.

All the switch work has been designed specially for its purpose; it is efficient and very easy to understand and keep in order.

The clock illustrated, is fitted with three interchangeable ¼ h.p. motors; it will operate dials up to 7 feet diameter and the hammers of bells weighing up to 1 ton.

The larger clock illustrated on the next page is capable of driving the hands of 20 ft. dials and striking on a 15-ton bell.

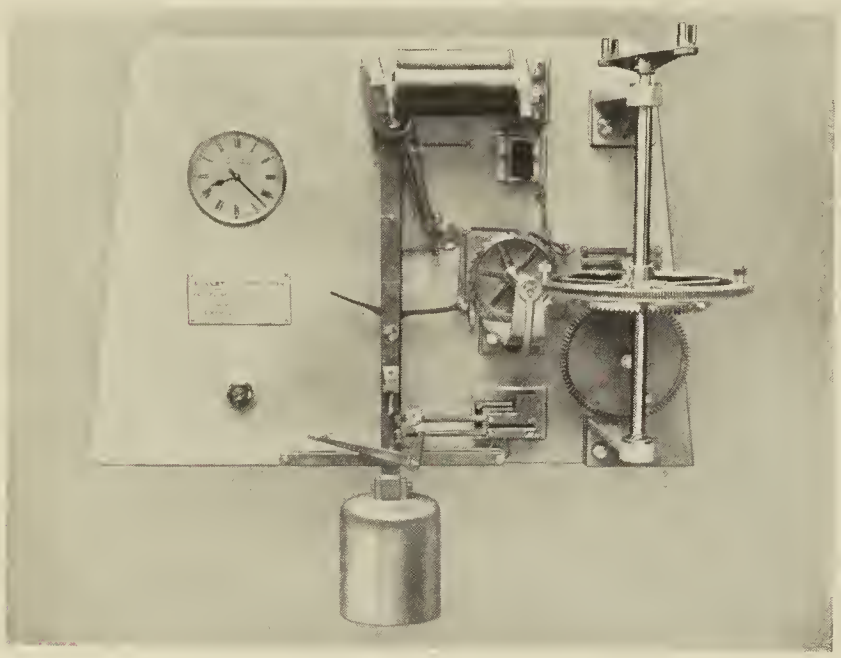
These clocks are made throughout by us at Croydon, and are thoroughly tested under working conditions before despatch.



Westminster Quarter Clock

Ottawa Parliament Buildings, Canada.
Electric Chiming Clock.

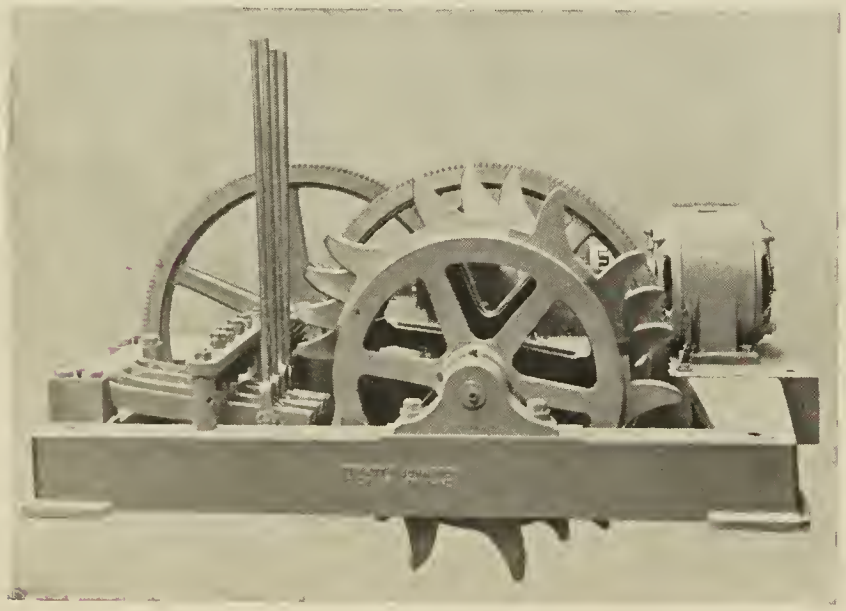
Driving four 15-ft. 9-ins. dials, striking the hours on a bell weighing 10 tons (22,400 lbs.) and chiming the Westminster Quarters on four of the smaller bells in the Carillon.



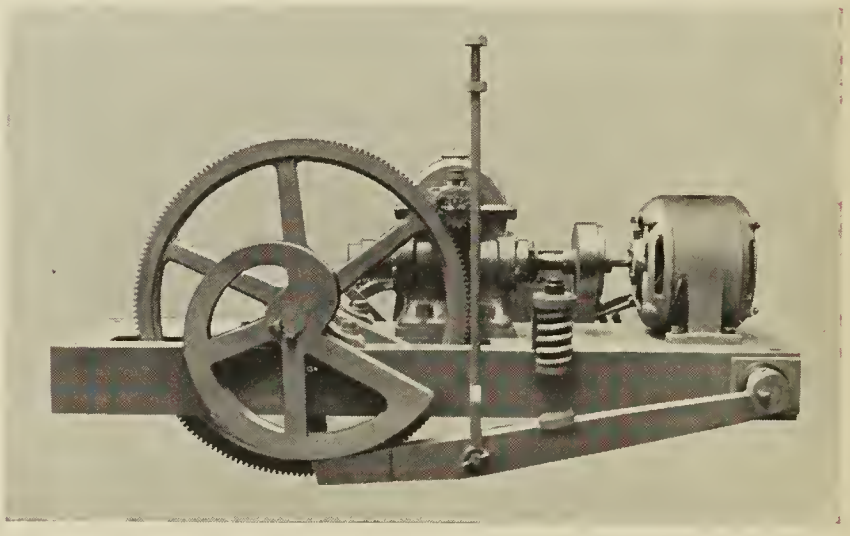
Going Train

"Hipp" type of electrical clock: controlled from a master clock. This portion of the Tower Clock Mechanism drives the hands of the four 15-ft. 9-ins. diameter Clock Faces, the connecting rod for the Dial-work leading upwards from the Worm Wheel on the right-hand side. It is placed in the centre of the Observation Room on the level of the lower edge of the Clock Faces.

The Machinery for striking the hours and for chiming the Westminster Quarters consists of very powerful motor-driven worm gearing released exactly at the right moment by the "Going Train." These gears are placed below the heavier bells in the lower portion of the belfry and are directly connected with hammers which strike on the outside of the bells. The motors are only in action while the blows are being struck, the Count-Wheel mechanism switching off the current automatically at the last stroke.



Quarter Train



Striking Train

Tower Clocks (Weight Driven)

EXPORT PRICES

No. "O" Timepiece Movement.

To enable clients overseas to arrive at an accurate estimate of the probable cost of a Tower Clock Installation in advance of obtaining our detailed tender and specification, we give on the next page a selection of prices covering clocks with opal dials suitable for the more usual sizes of towers.

These prices are based on the tower being of normal proportions and presenting no undue difficulty as to locating the mechanism; they are also subject to alteration without notice.

With each clock, other than non-striking, we give suggested weights of bells, chosen in proportion to the diameter of the dials.

The prices for Non-Striking Clocks cover the clock movement, complete with its weights, pulleys, dials, motion work, bevel wheels, connecting rods and joints, all packed for export and delivered f.o.b. London Docks.

The prices for Hour Striking or Quarter Clocks include, in addition, the bell or bells, with suspension bolts and plates, clock hammers and cranks, and wire connections.

Tower Clocks which strike the hours should not strike a blow at the half-hour, as this causes confusion at 12.30, 1.0 and 1.30; also an increased length of fall is required for the weights, while the mechanism is weakened by providing for the extra blows.

The cost of Electrically Operated Tower Clocks is slightly higher than that of weight-driven clocks, and quotations can only be given when particulars of the electric current available and details of the tower are supplied.

Weights, Pulleys, and Steel Lines.

Tower Clocks (Weight Driven)

Price List of Clocks Packed for Export and Delivered f.o.b. London Docks

Timepiece (Non-Striking)

Size of Clock	Dial (Diameter)	Total Price	Additional Dials (each)
0	2′ 0″	£64 0 0	£12 10 0
1	3′ 0″	£84 0 0	£16 10 0
1	4′ 0″	£91 0 0	£23 0 0
1	5′ 0″	£100 0 0	£31 0 0
2	6′ 0″	£128 0 0	£44 0 0
3	7′ 0″	£192 0 0	£47 0 0
3	8′ 0″	£201 0 0	£56 0 0
3	10′ 0″	£228 0 0	£83 10 0

Striking (Hours only)

Size of Clock	Dial (Diameter)	Weight cwts. qrs. lbs.	Bell Note	Dia.	Total Price	Additional Dials (each)
1	2′ 0″	1 0 7	C	16½″	£124 0 0	£12 10 0
1	3′ 0″	2 0 0	G	21″	£142 0 0	£16 10 0
1	4′ 0″	3 0 7	F	24″	£158 0 0	£23 0 0
1	5′ 0″	5 0 0	D	29″	£185 0 0	£31 0 0
2	6′ 0″	8 0 0	A	35″	£254 0 0	£44 0 0
3	7′ 0″	10 0 0	A	37½″	£375 0 0	£47 0 0
3	8′ 0″	12 1 0	G	40″	£406 0 0	£56 0 0
3	10′ 0″	20 0 0	F	47″	£531 0 0	£83 10 0

Ting Tang Quarters

Size of Clock	Dial (Diameter)	Hour Bell Weight cwts. qrs. lbs.	Bell Note	Dia.	Total Weight of 3 bells cwts. qrs. lbs.	Total Price	Additional Dials (each)
1	2′ 0″	1 0 14	C	17″	1 2 27	£204 0 0	£12 10 0
1	3′ 0″	2 1 7	G	22″	3 2 21	£228 0 0	£16 10 0
1	4′ 0″	3 2 14	F	25½″	5 1 14	£256 0 0	£23 0 0
1	5′ 0″	5 0 0	D	29″	7 2 21	£288 0 0	£31 0 0
2	6′ 0″	7 1 0	B	33½″	11 2 14	£380 0 0	£44 0 0
?	7′ 0″	10 0 0	A	37½″	16 0 7	£543 0 0	£47 0 0
3	8′ 0″	14 2 0	G	42″	21 3 7	£610 0 0	£56 0 0
3	10′ 0″	20 0 0	F	47″	29 2 14	£751 0 0	£83 10 0

Westminster Quarters

Size of Clock	Dial (Diameter)	Hour Bell Weight cwts. qrs. lbs.	Bell Note	Dia.	Total Weight of 5 Bells cwts qrs. lbs.	Total Price	Additional Dials (each)
1	2′ 0″	1 3 0	A	20″	3 0 17	£271 0 0	£12 10 0
1	3′ 0″	2 1 7	G	22″	4 0 21	£287 0 0	£16 10 0
1	4′ 0″	3 2 14	F	25½″	6 0 18	£315 0 0	£23 0 0
1	5′ 0″	5 0 0	D	29″	9 0 0	£361 0 0	£31 0 0
2	6′ 0″	7 1 0	B	33½″	13 2 7	£459 0 0	£44 0 0
3	7′ 0″	10 0 0	A	37½″	18 1 21	£631 0 0	£47 0 0
3	8′ 0″	14 2 0	G	42″	24 3 14	£712 0 0	£56 0 0
3	10′ 0″	20 0 0	F	47″	33 2 21	£872 0 0	£83 10 0

Projecting Clocks

Fig A

A Projecting Clock should be designed by the Architect of the building, and in harmony with the character of the structure.

The diameter of the dials should be about one-tenth the elevation at which they are placed ; they should preferably be two in number and the ornamental case or drum should not be too wide as measured from dial to dial, so as to secure the most pleasing proportions.

The materials must be of the best possible quality to minimise the cost of repairs in the future, and the design and construction such as to ensure the safety of the public.

Architectural forms of projecting clocks, of which Figs. A and B are representative, are usually made of teak or oak supported on steel girders hidden by the lower mouldings of the case. Occasionally bronze castings are used, as in Figs. C and E ; this construction is the most durable of all. In Fig. D the ornamental brackets are of acetylene-welded wrought iron and the body is of galvanised iron or copper, built up on steel angle framework with zinc mouldings.

Fig. B

Fig. C

In Fig. F—an effective and durable type adopted as standard by the Western Telegraph Co., for their offices in South America—the brackets are of cast iron and the circular drum of stout galvanised sheet iron or copper.

We operate these clocks either by weight-driven or electric movements. They are not arranged for striking or chiming.

In the case of weight-driven clocks the movement is usually fixed immediately behind the projecting clock but inside the

Projecting Clocks—*(continued)*

Fig. D

building. Space must be arranged for this movement in its protecting wooden case, and also a shaft must be left through the floors for the clock weights.

With electric clocks the hands of each dial are fitted with a small self-contained step by step movement, and a master clock operates these from any convenient position in the building.

The dials are of pure white opal glass and are, if required, illuminated from within. It is essential that the candle-power of the lamps should be ample, otherwise the effect at night is unsatisfactory. Two dials 3′ 0″ diameter require four 60-watt gas-filled lamps placed between them. We provide these lamps and the necessary wiring and fixtures when required, the clock being assembled and the lighting tested in our factory before despatch.

Fig. E

Decoration for painted work is in dark sage green, with relief in gold; teak or oak is usually left in oil finish, although sometimes, as in Fig. A, covered with English Gold Leaf.

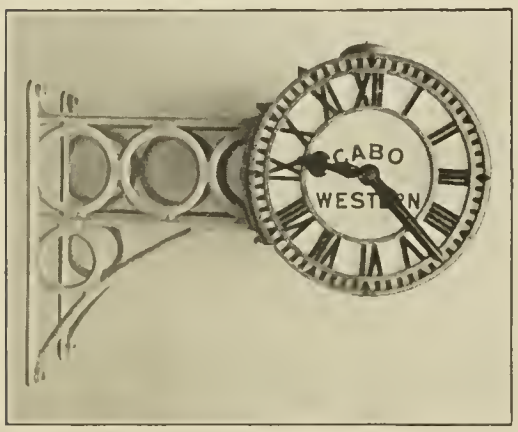


Fig. F

For advertising clocks the wording for metal cases is in white opal glass, illuminated from within (Fig. D), and for teak or oak cases in cast bronze applied letters, as shown on the teak supporting beam in Fig. E.

For shipment abroad we pack and deliver F.o.b. London Docks, but for erection in England we are prepared to send our own skilled men, builders' work, with ladders and scaffolding being preferably the subject of a separate local contract.

The Great Clock for Riverside Church, N.Y. City, U.S.A.

FOR our Carillon of 72 bells, cast for the Riverside Church, New York, we have made the most powerful tower clock in the world.

Owing to the unusual size and weight of the bells, most of the mechanism had to be specially designed—the heaviest bell weighs over 18 tons, and the hour hammer striking on this bell weighs 1,008 lbs.

The timepiece (Fig. 1) is driven by a comparatively small lead weight which is wound up automatically through an endless chain approximately every hour, by an electric motor. The current for this motor is switched on and off at the required intervals by means of a vertical cam bar which rises and falls with the driving weight through a set distance.

Fitted to the timepiece is a specially designed mercury switch so arranged as to release the motor-driven quarter chiming gear (Fig. 2) and hour striking gear (Fig. 3). Both these gears are fitted with a very powerful driving mechanism in order to control the unusually heavy hammers which are necessary to bring out the full tone of the bells, and the equipment throughout is of exceptionally large calibre.

Fig. 1. Controlling Timepiece

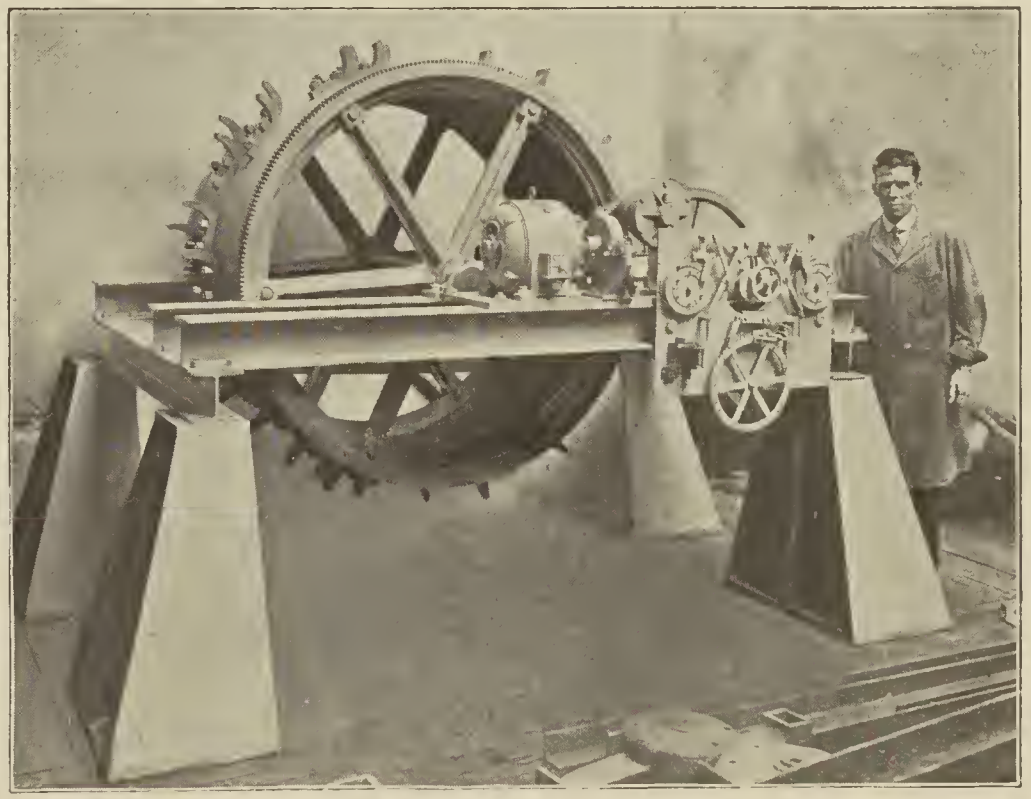


Fig. 2. Quarter Chiming Gear

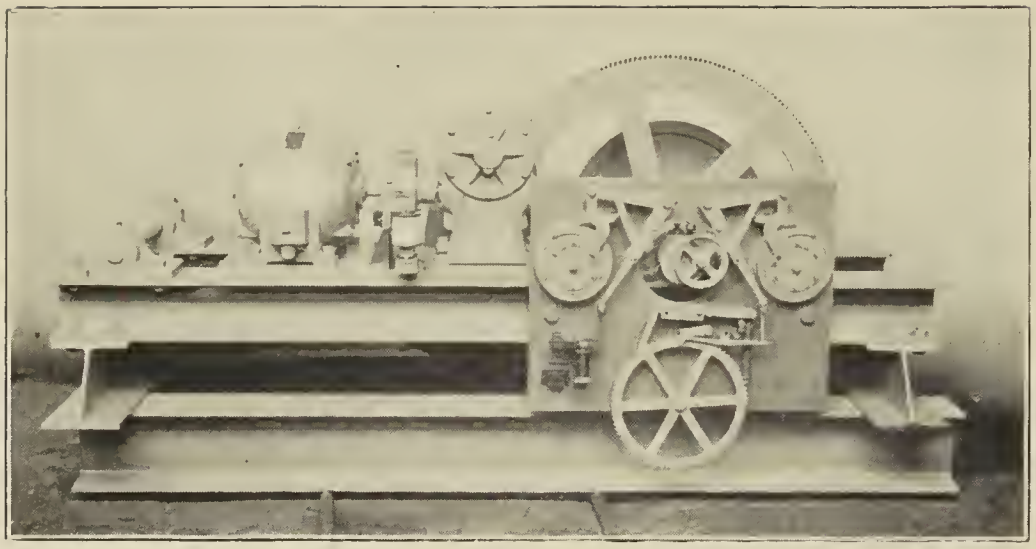


Fig. 3. Hour Striking Gear

The cam barrel of the chiming gear, which is 5ft. in diameter, is so planned as to allow the composition of the chimes to be altered from time to time. Fig. 4 shows the Bourdon Bell with the hour hammer and striking gear fitted in position on the bell-frame and on test, under working conditions, in our Factory. The gear consists of a large motor-driven cam which lifts the heavy hammer by depressing a lever and is so designed as to permit of the power of the blow being regulated to suit conditions in the tower. To avoid all possibility of the hammer head lying on the bell, and so deadening the tone, it is provided with three very powerful compression springs, which ensure an instantaneous rebound.

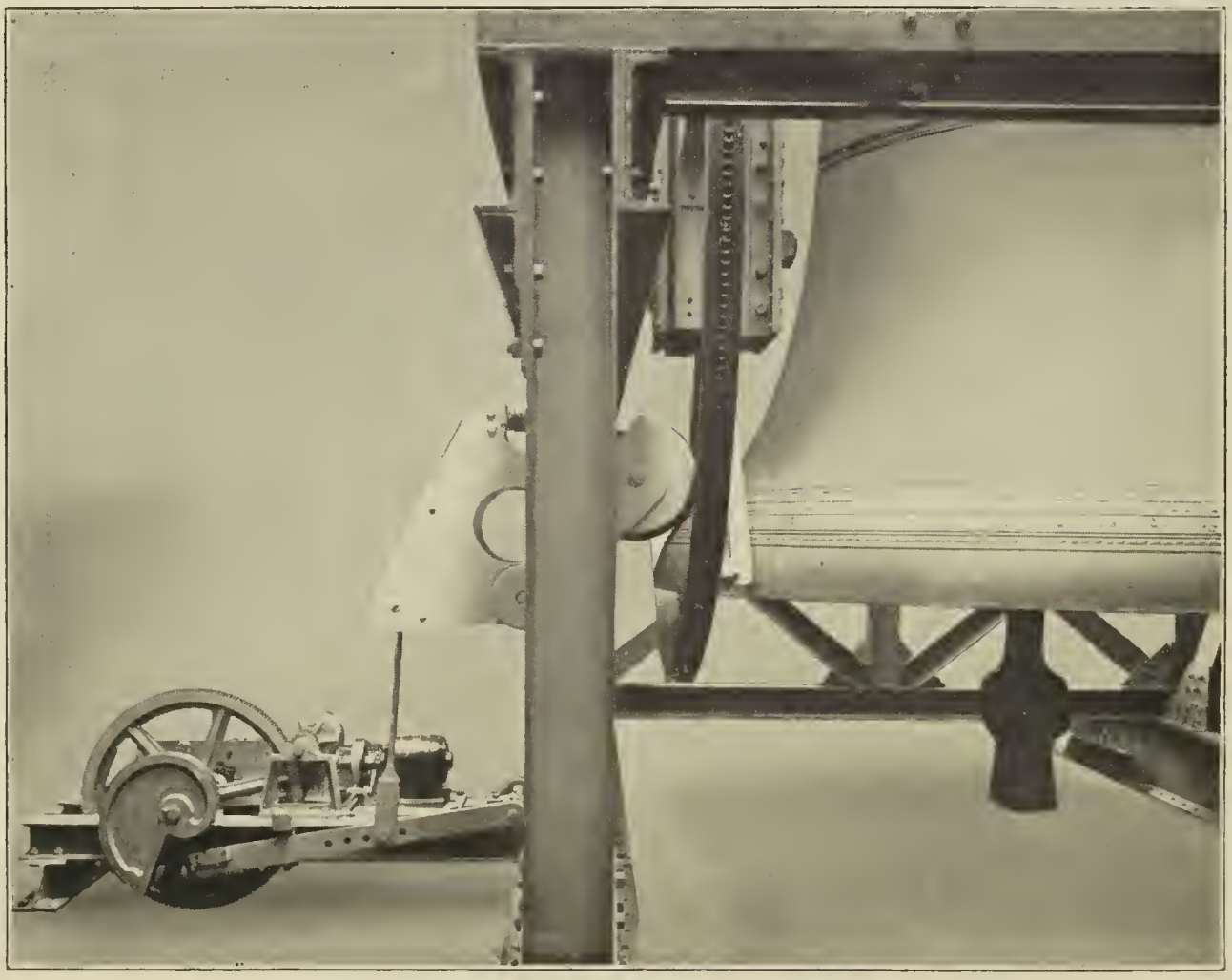
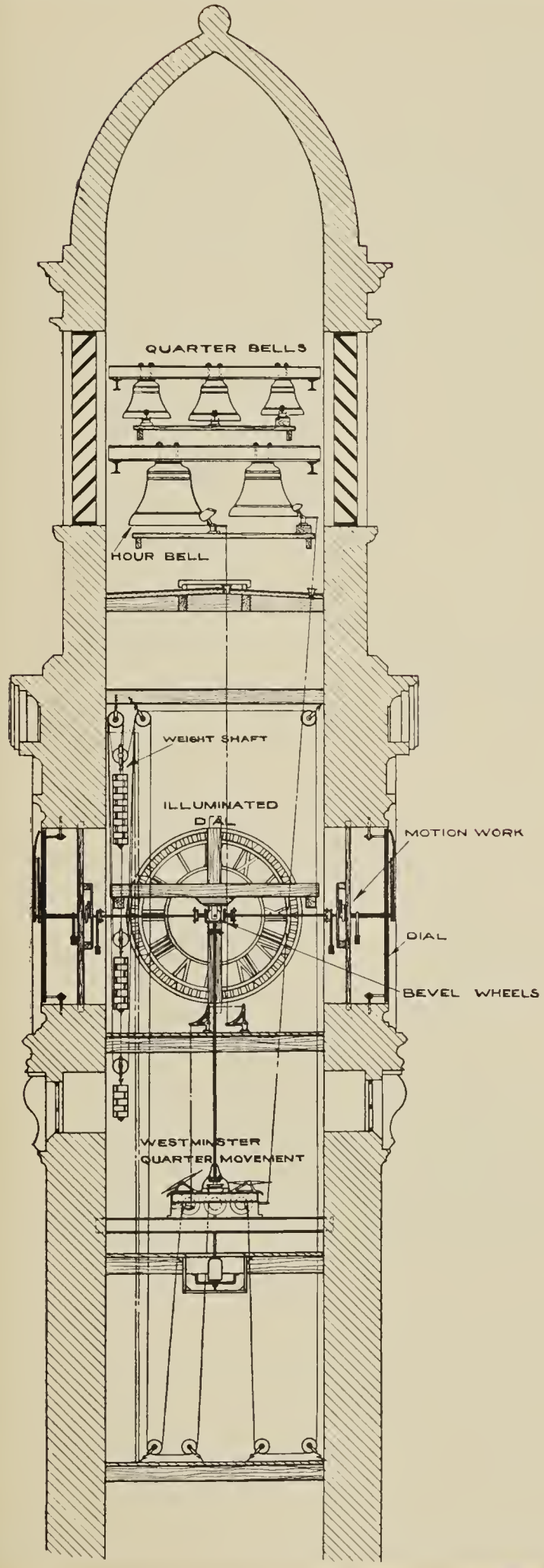


Fig. 4. Hour Striking Gear, Hammer, and Bell



Tower Clocks

Arrangement of Dials, Bells and Mechanism in the Tower

DIALS. These should be in proportion both to the height and width of the tower; a diameter equal to one tenth of the elevation is suitable when the tower is narrow, as in the illustration, but for a wider tower the diameter should be increased, the relative area of the clock face to that of the wall of the tower being, in this case, of more importance than the actual elevation. A clock face looks much smaller than expected when it is in place.

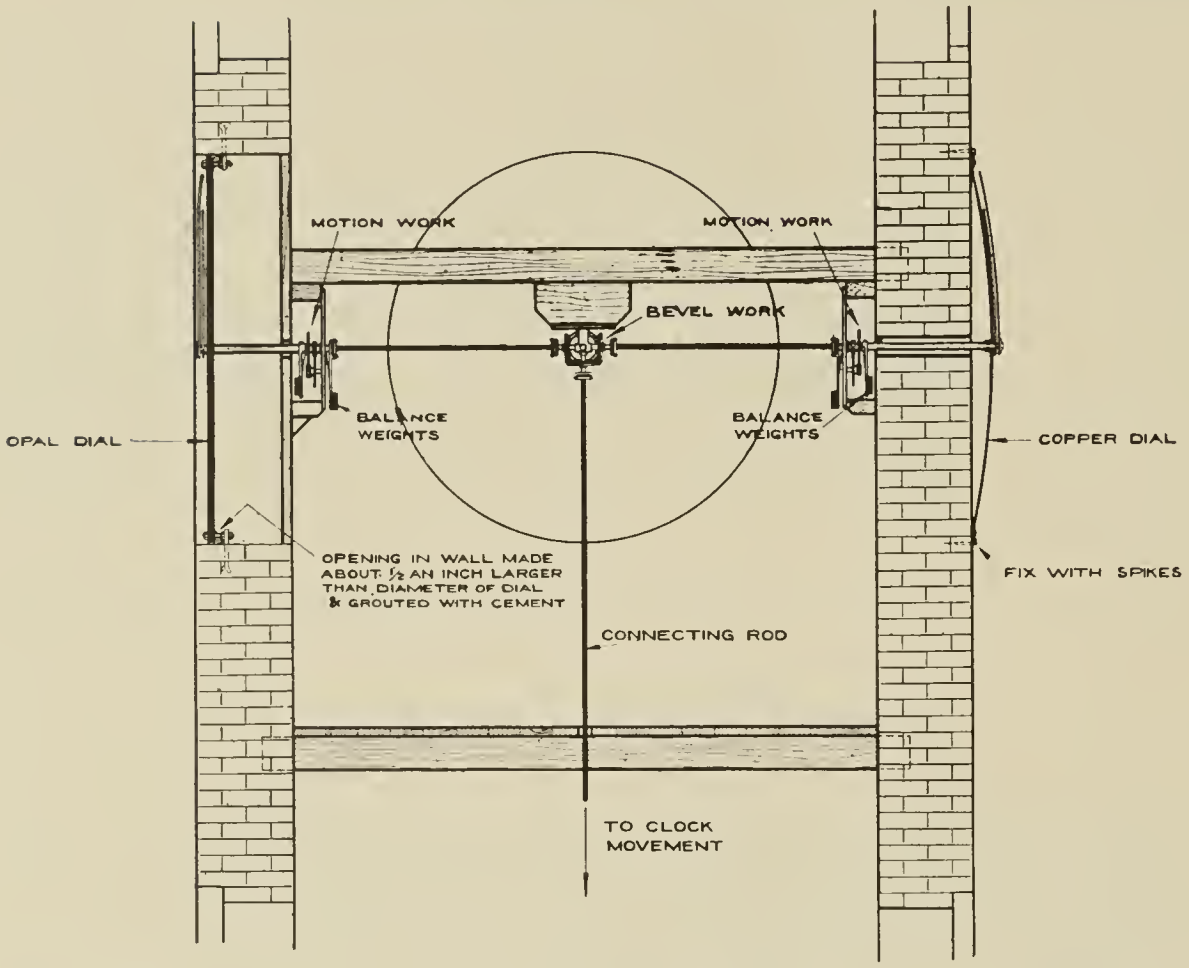
Opal Dials are used for illumination. They are let into a circular opening in the wall from $\frac{1}{2}$″ to 1″ larger than the nominal size of the dial. Illumination from outside the dial is not effective.

Copper Dials are screwed or spiked to the plain surface of the wall which, if existing, is drilled through at the dial centre with a hole about 2″ to 3″ diameter but which if new, should be prepared with an opening about 12″ square to provide access for oiling the spindles and tubes close up against their gunmetal support in the dial centre.

Skeleton Dials are usually fixed about 4″ to 6″ away from the wall so that they are not drawn up against any inequality of the surface. The hands are supported on the dial framework or in a gunmetal block let into the face of the wall at the dial centre.

BELLS. These are preferably arranged above the dials, with a weatherproof floor to the belfry. The hours are struck on a single bell and the quarters are chimed on two (Ting Tang), four (Westminster

Arrangement of Tower Clocks—(*continued*)



Quarter) eight, or ten extra bells. The openings in the belfry can be fitted with louvres if desired, but neither the bells nor the hammers and connections need any such protection and the sound escapes more freely through unrestricted openings.

The bells and hammerwork are supported on timber or steel beams supplied locally, or in a self-contained steel frame with all hammers and connections fitted and adjusted in our factory.

MOVEMENT. If this is placed in the dial chamber, headroom should be allowed between the floor and the connecting rods at the dial centres. It can be placed against the wall or in the centre of the room and can also operate from a lower level if desired.

For clocks with dials up to about 10 ft. diameter, the 1¼ seconds pendulum need not pass through the floor. The two seconds pendulum of a larger clock swings into the room below, from which it is regulated.

The most convenient position for the weights is usually in a corner of the tower. A Non-Striking Clock requires one set of weights, an Hour Striking Clock two sets and a Quarter Chiming Clock three sets of weights.

To prevent the steel wire cables being affected by the weather the weights should be suspended at a point immediately below the belfry floor and provision should be made for the fall to be as long as is possible, as with a short drop the strain, and consequently the wear and tear on the mechanism is much greater. Provision must be made to catch the weights at the bottom of the weight shaft should they fall, the best arrangement being a continuation of the weight-shaft below the ground floor level, which has the additional advantage of preventing them from spreading when they are checked at the bottom. It should also be made impossible for people to stand under the suspended weights—preferably by fixing a match-board casing.

GENERAL. If possible, traps should be prepared in all floors for hoisting the clock mechanism and bells through the centre of the tower.

Tower Clocks

OPAL DIAL. This consists of a cast iron frame work glazed with pure white opal glass. It is the most distinct dial made and looks well on any modern tower, being almost invariably used for Public Buildings, as it can be brilliantly illuminated at night by incandescent gas or electric light inside the building.

The hands, figures and minutes are finished in hard black enamel and the circles are gilded with best English gold leaf.

Tower Clocks

SKELETON IRON DIAL. This dial, which is cast in iron from the same pattern as the opal dial, but unglazed, is used when placed in front of louvres, openings, or ornamental masonry. It shows the time distinctly but does not spoil the architectural effect of the Tower, the lines of the building appearing through it.

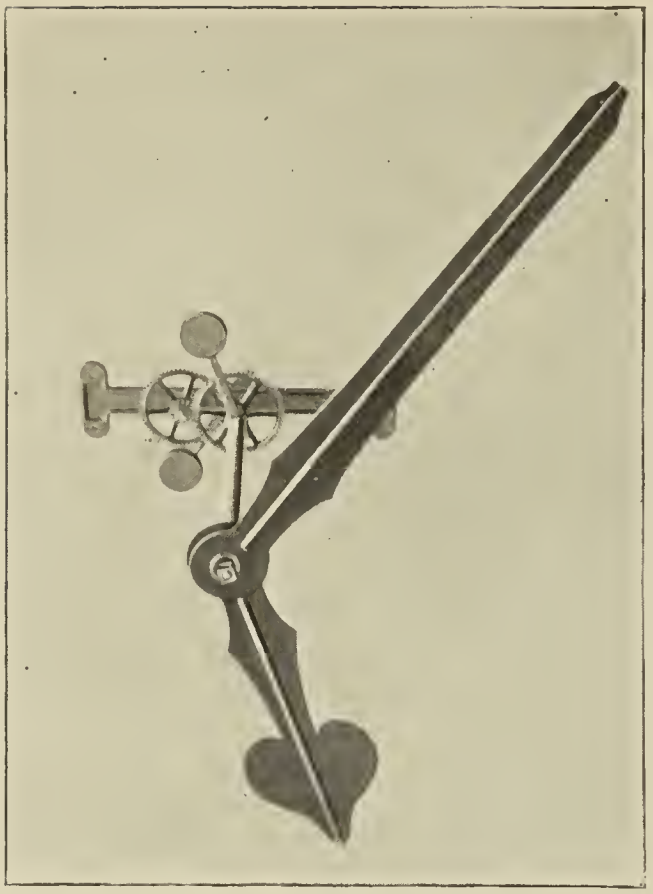
The hands, figures and minutes are gilded with best English gold leaf and the circles finished in hard black enamel.

Tower Clocks

COPPER DIAL. This is made from a single sheet of thick copper, dished concave and stiffened round the edge with a semi-circular beading. It is especially suited to Church Towers where there is a sufficiently large flat surface on the wall, but it should not be used in front of louvres or ornamental masonry.

The hands, figures and minutes are gilded with best English gold leaf, and the ground work finished in hard black enamel.

Tower Clocks



Hands and Motion Work

HANDS. These are usually of hard sheet copper stiffened by a deep bead down the centre and pinned and soldered to a gunmetal back plate with a squared hole through the boss to secure the hand to the minute and hour arbors.

External counterpoises, which are unsightly, are avoided. The balance weights are fixed inside the Tower and far enough back to avoid casting shadows on an illuminated dial.

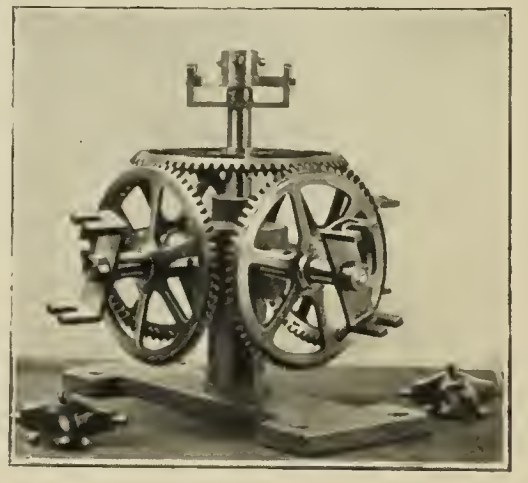
The shape of the hands has been arrived at by experience ; they are of pleasing proportions and can be seen well from a distance.

Hands of special design can be made at an extra cost if required, but it must be remembered that an ornamental hand does not show the time so clearly and effectively as the simple and well balanced type that we have adopted as our standard.

MOTION WORK. The Motion Work, or gearing, on which the hands are fixed and which gives the relative speed of 12 to 1 between the hour and the minute hands, is fitted with gunmetal wheels ; the tubes on the smaller sizes up to 5 ft. dials are of brass and above this size of steel. On the largest dials, they are of phosphor bronze, with both minute arbor and hour tube working on ball bearings totally protected from dust and water. The motion work is secured to timber or metal supports spanning the circular dial opening in the case of an illuminated dial, or direct to the wall on the inside of the building when there is no circular opening for the dial. The weight of the hands is taken by a gunmetal bush in the centre of the dial.

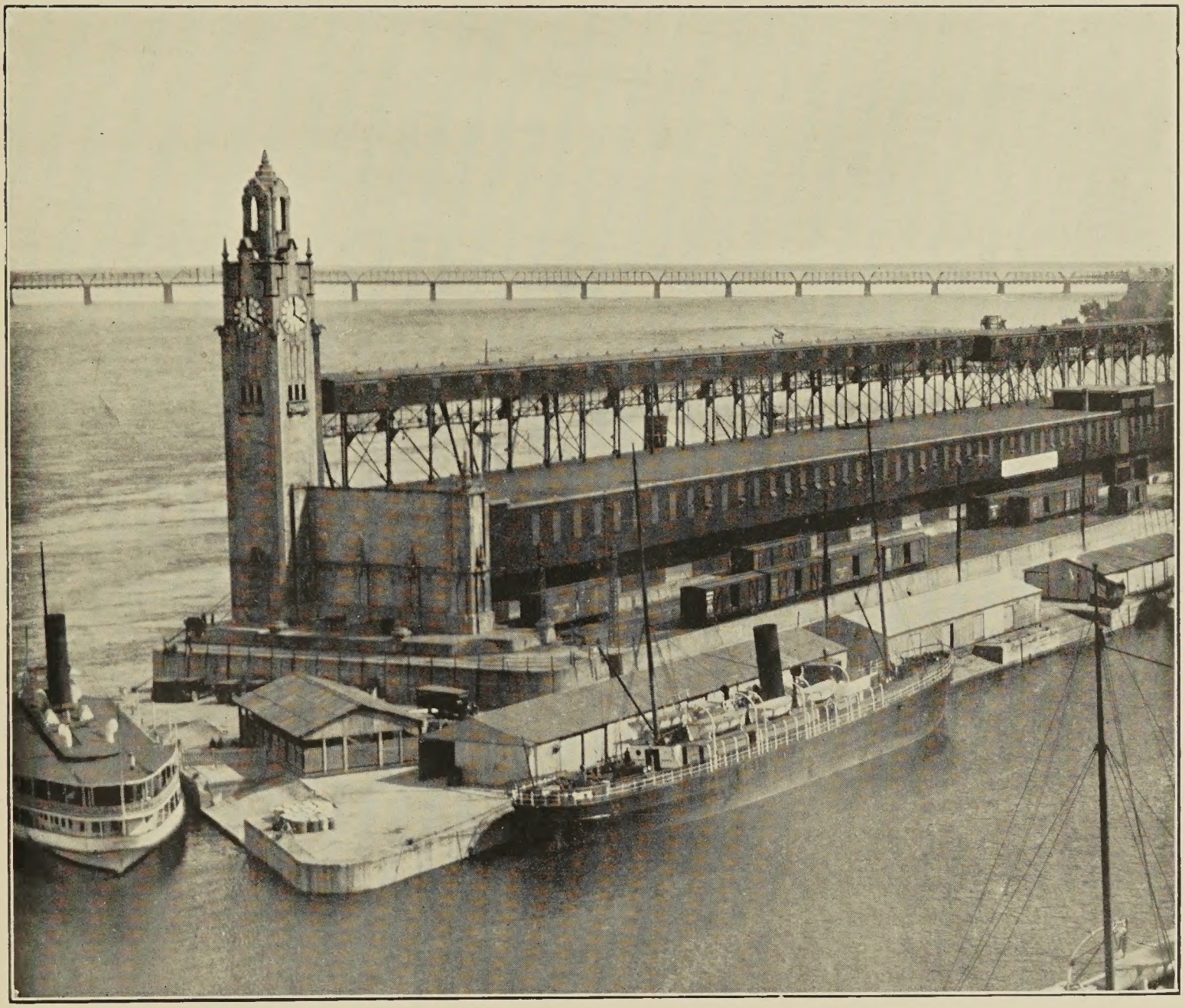
BEVEL WHEELS. These are of gunmetal, of large diameter to reduce backlash while still giving ample freedom, and are arranged so as to transmit the motion of the clock movement to the hands in any direction through the steel connecting rods, which are fitted with joints allowing for expansion and contraction.

If the length of any vertical connecting rod becomes excessive the weight is taken on ball thrust washers.



Bevel Wheels

Tower Clocks



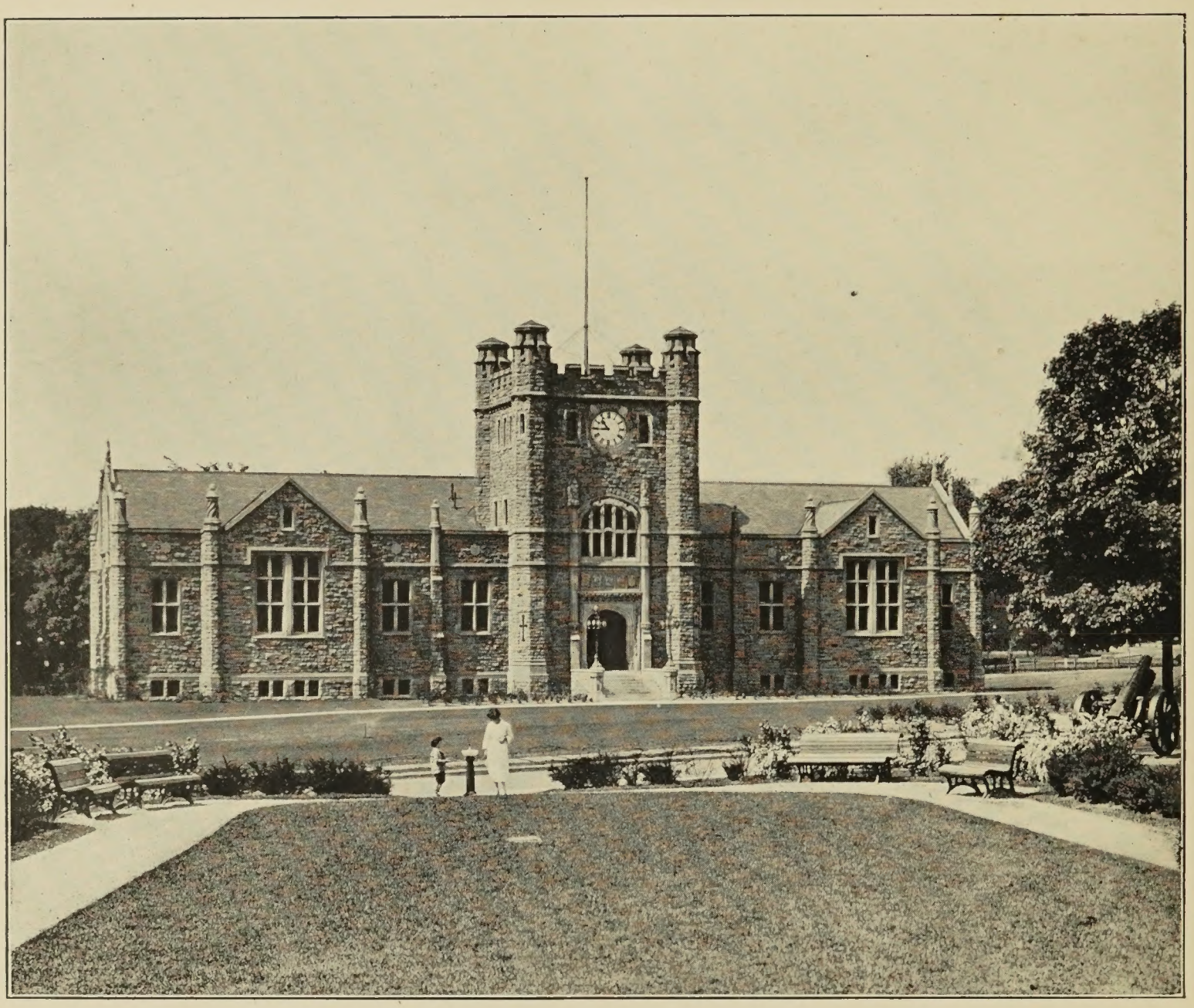
Montreal Harbour Memorial Tower

Quebec, Canada

1922

The Clock, which gives the time to the Shipping in the Port of Montreal and on the St. Lawrence river, has four illuminated faces 12′—0″ diameter ; the hands are operated by a very powerful weight-driven movement, fitted with an electric motor to give automatic winding every three hours, with a margin of twenty-four hours for safety should the local current fail. In this case an electric bell rings in the caretaker's office, and the clock is wound by hand daily until the local current is again available.

Tower Clocks



Westmount Town Hall

Quebec, Canada

1922

The Clock has a Gunmetal Illuminated Dial 6′—0″ diameter. The weight driven movement has a large margin of power in reserve to overcome the resistance of driving the hands under the severe climatic conditions experienced in winter, while the accurately compensated pendulum ensures correct time-keeping irrespective of the extreme variations in temperature.